Journal of the Royal Microscopical Society

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS

AND

A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia)

MICROSCOPY, &c.

EDITED BY

R. G. HEBB, M.A. M.D. F.R.C.P.

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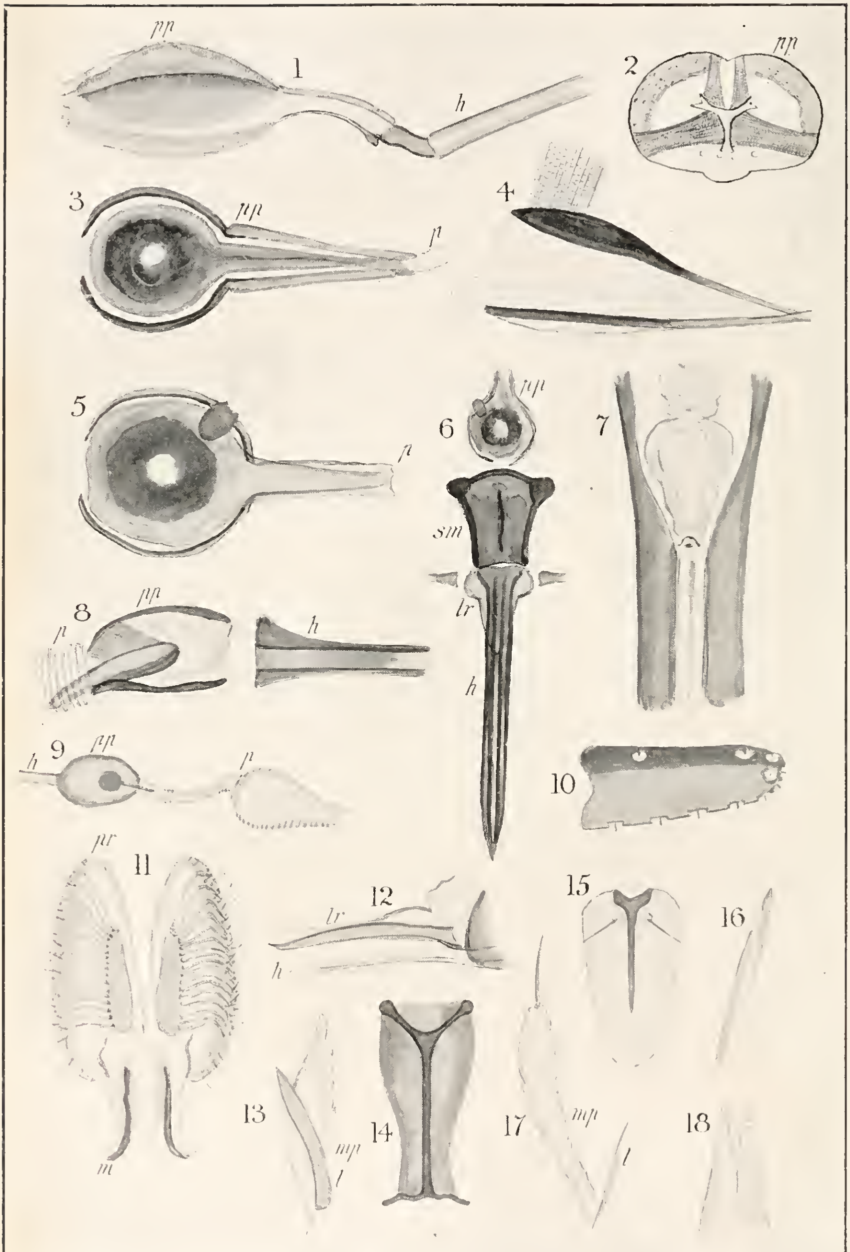
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JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

FEBRUARY, 1909.

TRANSACTIONS OF THE SOCIETY.

I.—*The Mouth-parts of the Nemocera and their Relations to the other Families in Diptera. Corrections and additions to the paper published in* 1904.

By W. Wesché, F.R.M.S.

(*Read October* 21, 1908.)

Plates I. to IV.

A paper covering so wide a field as the one referred to above, cannot be, nor had it any pretensions to be exhaustive, and the exceedingly minute size of many of the parts examined, and the occasional failures of preparations to give clear views, have caused one or two mistakes in the homology, and two species have been wrongly determined. On the other hand, many more species have

EXPLANATION OF PLATE I.

Note.—The following letters are used throughout the plates.

m	Mandible.		*pr*	Paraglossa.	Labium.
l	Laciuia.	Maxilla.	*lg*	Ligula.	Labium.
g	Galea.	Maxilla.	*lp*	Labial palpus.	Labium.
mp	Maxillary palpus.	Maxilla.	*pg*	Palpiger.	Labium.
pf	Palpifer.	Maxilla.	*mn*	Mentum.	Labium.
s	Stipes.	Maxilla.	*sm*	Submentum.	Labium.
c	Cardo.	Maxilla.	*lr*	Labrum.	
h	Hypopharynx.		*p*	Pharynx.	
pp	Pharyngeal pump.		*cl*	Clypeus.	

Fig. 1.—The pharyngeal pump in *Culex pipiens* L.; dissected out from the head; the anterior portion is connected with the base of the hypopharynx, which is shown on the right.

,, 2.—Section of the head, showing the muscular attachments of the pharyngeal pump.

[Continued on next page.

been examined, and a review of the trophi in the peculiar family of the Phoridæ has shown so many fresh points, that additions are desirable.

I propose to keep to the arrangement of groups, and will as formerly, for the sake of ease in reference, make any remarks on family or genus in the section devoted to that group.

Group 1.—All parts distinguishable, except the labial palpi, which are aborted.

Simulidæ. (Type *S. reptans* L.)
Culicidæ, the females only.
Tabanidæ, „ „ „
Asilidæ.

Group 2.—The mandibles are fused into the labium, and the labial palpi are aborted.

(*a*) *Raptorial, or blood-sucking.*
Empidæ, with exceptions.
Leptidæ, „ „ (Type *L. scolopacea* L.)
The genus *Ceratopogon* of the Chironomyidæ.

EXPLANATION OF PLATE I.—*cont.*

Fig. 3.—Pharyngeal pump in *Asilus crabroniformis* L. The position is different from that in *Culex*, the anterior portion being to the left.
„ 4.—Diagram showing a lateral view of fig. 3, and showing how the part is worked in this species.
„ 5.—Pharyngeal pump in an undetermined *Asilus* from Pegu.
„ 6.—The same, on a small scale, showing the submentum and the hypopharynx, to show their relative positions.
„ 7.—Portion of the base of the hypopharynx of *Asilus* from Pegu, to show a supposed poison-gland.
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„ 17.—Lacinia and maxillary palpus of *L. flavicauda*.
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(*b*) *Suctorial.*

Mycetophilidæ.
Psychodidæ.
Culicidæ, the males only and the genus *Corethra.*
Rhyphidæ. (Type *R. fenestralis* Scop.)
Tabanidæ, the males only.
Lonchopteridæ.
Bombylidæ.
Platypezidæ.
Syrphidæ.

Group 3.—The mandibles are fused into the labium, the laciniæ and galæ of the maxillæ and the labial palpi are aborted.

Cecidomyidæ.
Chironomyidæ, except the genus *Ceratopogon.* (Type *C. plumosus* L.)
Tipulidæ.
Stratiomyidæ.
Conopodæ.

Group 4.—The mandibles are fused into the labium : all parts of the maxillæ except the stipites and cardines are aborted, or if remnants of the laciniæ are present, the stipites and cardines are aborted or vestigial. The palpi present are labial, and the tracheæ of the paraglossæ (labella) are only moderately developed.

Bibionidæ. (Type *B. hortulanus* L.)
Dolichopodidæ.
Phoridæ.

Group 5.—The mandibles are fused into the labium ; all parts of the maxillæ except the stipites and cardines are aborted, the palpi present are labial, the tracheæ of the paraglossæ are well developed.

(*a*) *With remnants of maxillary palpi.*

Some Tachinidæ.
Some Muscidæ. (Type *M. domestica* L.
Some Anthomyidæ.
Some Chloropodæ.

(*b*) *With no remains of maxillary palpi.*

Pipunculidæ, with exceptions.
Some Tachinidæ } Particularly highly modified genera, such as *Siphona* or *Stomoxys.*
Some Muscidæ }
Some Anthomyidæ. (Type *C. erythrocephala* Mg.)
Cordyluridæ.
Ortalidæ.
Trypetidæ.
Lonchæidæ.
Some Chloropodæ.
Hippoboscidæ.

Group 6.—The mandibles are fused into the labium; the cardines, stipites and laciniæ of the maxillæ are present, the latter leaf-shaped and pubescent; the paraglossæ are without teeth; the palpi are labial.

Phycodromidæ. (Type *Coelopa frigida* Mg.)
Helomyzidæ.
Sciomyzidæ.
Psilidæ.
Sapromyzidæ.

Group 7.—The mandibles are fused into the labium; the maxillæ are imbedded, the palpi being the only part exposed, labial palpi are also present; the tracheæ of the paraglossæ are more or less well developed.

Opomyzidæ.
Sepsidæ.
Ephydridæ.
Drosophilidæ.
Borboridæ. (Type *B. equinus* Fln.)

EXPLANATION OF PLATE II.

Fig. 19.—Maxillary palpus, stipes, and cardo of *Culex annulipes* Mg. ♀, to show the atrophied fourth joint which is absent in *C. pipiens* ♀.
,, 20.—End of lacinia of maxilla of an undetermined species of *Culex* ♀ from Windsor, Nova Scotia, for comparison with the same part on fig. 21 *C. annulipes* ♀, a British species. This and fig. 21 have been carefully drawn to scale to show the exact relative size.
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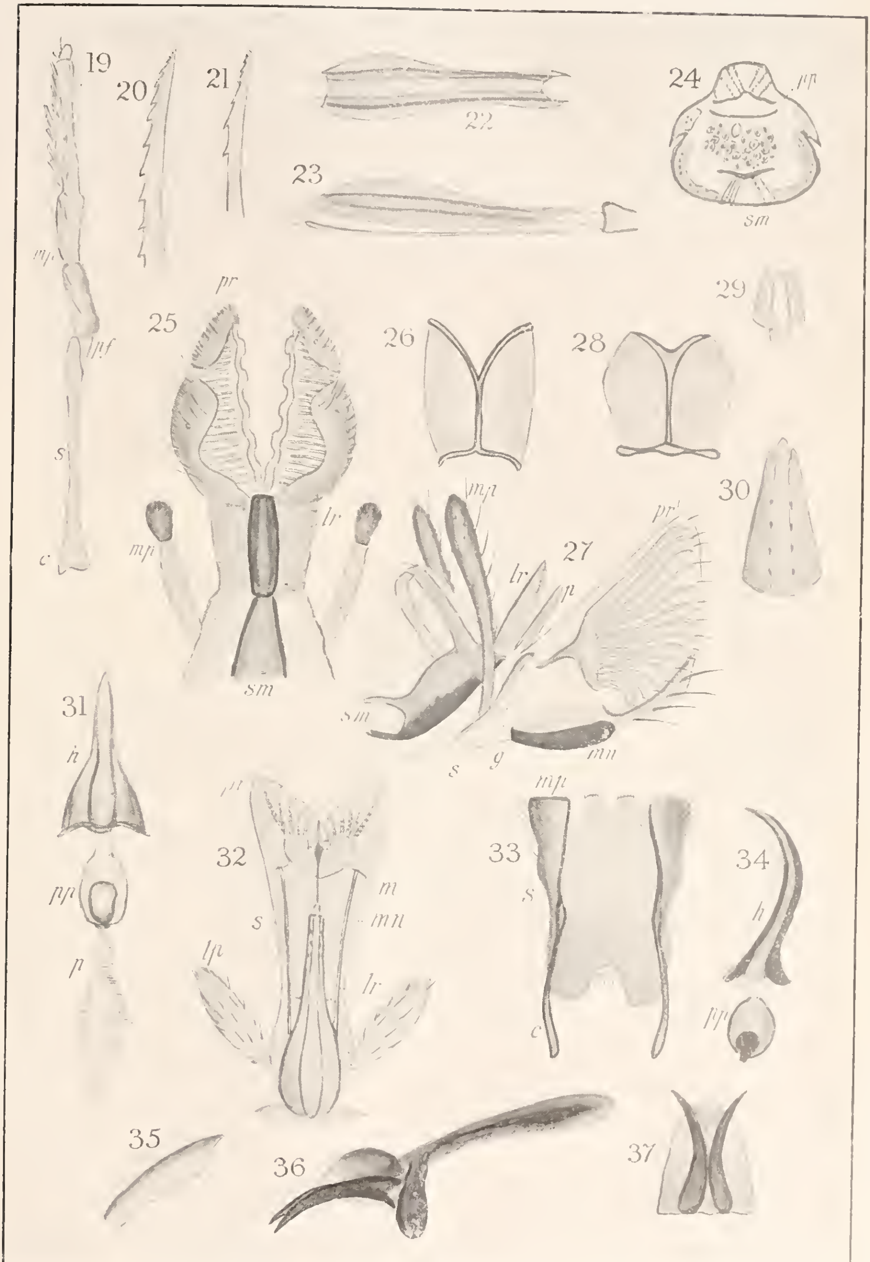
,, 25.—Trophi of *Chloromyia formosa* Scop. Dorsal view.
,, 26.—Mentum of *C. formosa*. Removed from the ventral side of the labium, and showing the median suture (imbedded mandibles).
,, 27.—Trophi of *Callimyia speciosa* Mg. A genus of the Platypezidæ. Lateral view.
,, 28.—Mentum of *Platypeza consobrina* Ztt.
,, 29.—Hypopharynx of *P. consobrina*.
,, 30.—Labrum of *P. consobrina*.
,, 31.—Hypopharynx, pharyngeal pump, and portion of pharynx of an undetermined species of the genus *Dolichopus*.
,, 32.—Trophi of *Gymnopternus assimilis* Staeg. Dorsal view.
,, 33.—Dissection of the labium of *Aphrosylus raptor* Hal. Dorsal view. The muscles and the ventral plate have been removed. The mentum can be clearly seen, and the absence of a median suture noted.
,, 34.—Hypopharynx and pharyngeal pump of *A. raptor*. Lateral view.
,, 35.—One of two plates (mandibles) imbedded in the muscles on the ventral side of the labium of *A. raptor*.
,, 36.—Labrum of *A. raptor*. Lateral view, and showing the lever which works the part.
,, 37.—Part of the labrum of *A. raptor*. Flattened out and seen from the dorsal side.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Group 8.—All parts atrophied.
Œstridæ. (Type *G. equi* F.)
The genus *Oncodes* of the Cyrtidæ.

Pulicidæ.—With regard to the inclusion of the Pulicidæ in the order Diptera, some of my preparations of *P. irritans* L. ♀ show a very characteristic "chyle stomach," and a single receptaculum seminis in the abdomen, which seem very close to similar organs in Diptera. On the dorsal part of the ovipositor of *Pipunculus campestris* Ltr. is an organ which, from its situation, and from a certain superficial likeness, appears to be homologous with the well-known pygidium of the flea. These are three items of evidence in favour of their being retained in the classification.

A study of the phylogeny of the Phoridæ has necessitated a review of the trophi of the large majority of the families, and this has led to the knowledge that in the mouth there is an additional character which separates the two great divisions of Diptera, the Orthorrapha and the Cyclorrapha.

All the families with complete mouth-armature are in the Orthorrapha, but in other families, when the mandibles disappear, they are imbedded in the ventral side of the labium, as in *Bibio hortulanus* L. and *Tipula oleracea*, or *Dolichopus griseipennis* Stan., while in the Cyclorrapha they are imbedded on the dorsal side, as in *Helophilus pendulus* L., and *Calliphora erythrocephala* Mg.; or, to put the matter in a simpler way: In the Orthorrapha (*a*) when the mentum is developed, a median suture or thickening of the chitin is present; (*b*) when undeveloped, paired rods will be found on the ventral side of the labium. In the Cyclorrapha the median line of the mentum is not indicated by a suture.

This character is fresh evidence that the two great divisions of Diptera are natural, and makes the task of classification easier (plate I. figs. 14, 15, and plate IV. figs. 59, 60).

Group 1.—The presence in several families of an organ somewhat similar to the pharyngeal pump in *Culex*, has directed my attention to that part. I borrow the nomenclature from Dr. Nuttall's and Mr. Shipley's paper on Anopheles.* It consists of three chitinous plates, situated in the head and forming a chamber having ducts leading to the pharynx and the buccal cavity. These plates are attached by muscles to the head walls, and when pulled back by them, create a vacuum which sucks up the blood or fluid through the hypopharynx, which is prevented from returning by a valve in the anterior duct. It seems to be formed from the pharynx, which at this point often consists of a chitinous tube. Its presence in such very old families as Ptychoptera, Tipula, and the Australian genus *Gynoplistia* shows it to be a very archaic

* Journ. of Hygiene. i., No. 1 (1901).

character, though I am not prepared to formulate any homologies with typical forms such as *Periplaneta* or *Forficula* (plate I. figs. 1, 2.

The palpi of the females in *Culex* are practically three-jointed, while in the males they are usually more developed and are four-jointed. The process of degeneration can be seen in *C. annulipes* Mg., where an atrophied joint is found on the distal end, making a fourth joint, the usual number in the Nemocera (plate II. fig. 19). Similar conditions exist in *C. dorsalis* Mg., and also in a mosquito from Perak, *Desvoidia ventralis.* This atrophying joint is also found in similar situations on the palpi, both labial and maxillary, of *Forficula*, and in the latter case seem to have some particular function, as they bear minute sense-organs on the tip.

The Transatlantic stories of mosquito bites are often suspected of exaggeration; yet it is curious that the maxillæ of a species captured at Windsor, N.S., are far more barbed and stronger than our *C. pipiens* L., or *C. annulipes* Mg. The labium is thicker than that of *C. pipiens*, and is considerably shorter than that of *C. annulipes* (plate II. figs. 20, 21).

The pharyngeal pump in *Asilus* is situated in the same position, but differs from that in *Culex*, in consisting of only two plates, the upper fitting into the raised sides of the lower, and connected with it at all points by a membrane. Both plates are somewhat circular and send out a process at the posterior end. The upper plate at this posterior end broadens out, and is held by the sides of the lower plate, which overlaps, making a kind of articulation; and the other portion of the upper plate is free to move, and is raised

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EXPLANATION OF PLATE III.

Fig. 38.—Trophi of *Phora curvinervis* Beck. ♀. Dorsal view. The wide spreading of the paraglossæ is as the parts appear in a preparation mounted with pressure. I think the natural position is like that of the male in fig. 39.

,, 39.—Labium of *P. curvinervis* ♂. Seen from the ventral side, and showing the mentum.

,, 40.—Hypopharynx of *P. curvinervis* ♂.

,, 41.—Labrum of *P. curvinervis* ♂. To show how remarkably this part differs in the sexes.

,, 42.—Palpus of *P. curvinervis* ♂.

,, 43.—Labrum of *Phora lutea* Mg. (Aphiochæta) ♀.

,, 44.—Hypopharynx of *P. lutea* ♀.

,, 45.—Fused laciniæ of the maxillæ and teeth from the paraglossæ of *P. lutea* ♀.

,, 46.—Palpus of *P. lutea* ♀.

,, 47.—Labrum of *Phora incrassata* Mg. ♀. Dorsal view.

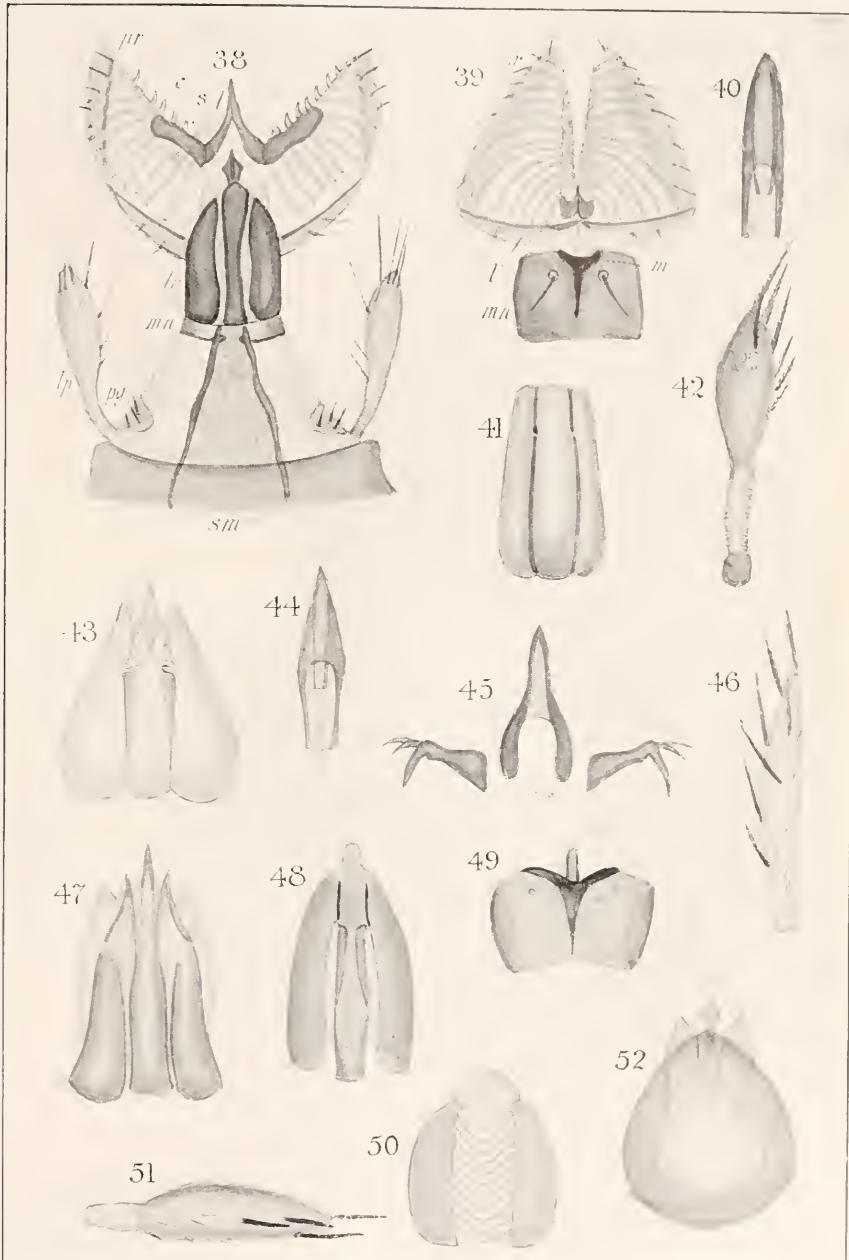
,, 48.—Labrum of *P. incrassata* ♂. Dissected out and seen from underneath, when the complicated folds of the double plate can be seen.

,, 49.—Mentum of *P. incrassata* ♂. The sides are bent over, indicated by the shading in the drawing.

,, 50.—Labrum of *Conicera atra* Mg. ♀. Dorsal view.

,, 51.—Palpus of *C. atra* ♀.

,, 52.—Labrum of *Phora ruficornis* Mg. ♀. Dorsal view.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by muscles; the posterior end or hinge of the upper plate, when this occurs, closes the pharynx, and so creates a vacuum: a mechanism which differs from that of *Culex*. This is described from *A. crabroniformis* (plate I. figs. 3, 4).

An undetermined *Asilus* from Pegu shows a curious bulb fitting into the right side of the lower plate, forming a valve; also a membranous gland which runs down to what appears to be an opening in the hypopharynx: judging from some remarks of Professor Poulton on the instantaneous death of the prey of some Asilids, this may be a poison-gland * (plate I. figs. 5–7).

As I pointed out in the former paper, the Asilidæ have Nematocerous characters, and the presence of an organ found in the older families is quite in harmony with that observation; but, as I shall show later, homologous organs exist in two other families in the Brachycera, and form valuable proofs of affinity.

The long labium of *Chrysops cæcutiens* L., which is figured in plate iv. of the 1904 paper, is articulated by the membrane at the base folding on itself, forming a fitting which holds the part in any required position; a precisely similar arrangement is found in many of the Empidæ.

Group 2.—The Empidæ are such keenly predaceous insects that the pharyngeal pump would be of value, and retained. I find it in some species in my collection in various stages of development. It is, however, used in a different manner, as there is a piston working in the cavity which seems to be drawn back into the pharynx; this piston varies in shape in some genera; in *Hybos* I can see muscles attached to it. It seems absent in *Empis stercorea* L., but I have preparations that show it in *Hybos femoratus* Müll., *H. grossipes* L., *E. livida* L., *Tachydromia cursitans* F., and *T. maculipes* Mg. (plate I. figs. 8, 9).

I have observed that the inner tube of the hypopharynx in *H. femoratus*, *E. stercorea*, and several other species, is ciliated.

The hard chitinised labium of *Hybos* shows a few "taste-cups" —these structures are new to me on the labium of Diptera. The labium in the Asilidæ, which is developed on similar lines, bears the usual "taste-hair," with a socket standing out of the supporting chitin (plate I. fig. 10).

In *E. livida*, *E. stercorea*, and in those genera in which the labium is long and membranous at the base, the membrane is folded on itself and forms an articulation, precisely as in *Chrysops*.

All the preparations of Empidæ I have examined show the mandibles fused into the mentum on the ventral side.

The mouth-parts of the Leptidæ have several features which were omitted in my previous description, and are of some importance, as they show an affinity with several other families.

* Predaceous Insects and their Prey. Trans. Ent. Soc. London, Jan. 1907.

The tracheæ spring from chitinous plates on each side of the deep cleft of the paraglossæ. The taste-hairs on the side of the paraglossæ are numerous. The mandibles are imbedded on the ventral side, but are in *L. conspicua* Mg. separate and laterally placed, while in *Chrysopilus auratus* F. they are soldered into the mentum in the median line (plate I. figs. 11–14). The flaps of the paraglossæ (labella) curl upwards and form a case for the maxillæ, hypopharynx and labrum, and the exposed sides of the paraglossæ are far more chitinous than the inner or dorsal; several of these points are indicated in the figure of the trophi of *L. Scolopacea* L. (plate iv. fig. 19, 1904). I believe that, as far as is known, the blood-sucking habit is confined to the genus *Leptis*.

The Mycetophilidæ, Rhyphidæ, and the genus *Ceratopogon*, call for no further remark except that all the species examined show the mandibles imbedded in the under-side of the labium. In *Ulomyia fuliginosa* Mg. of the Psychodidæ, the mandibles show on the ventral side of the labium as a strong rod with a bifurcation at its anterior end.*

* Since going to press, I have, through the kindness of Mr. H. J. Waddington, had an opportunity of examining some preparations of *Mochlonyx velutinus* Ruthé. This Culicid has a mouth somewhat like *Corethra*, and I can clearly make out the pharyngeal pump. It is therefore obvious that the long styliform labium of the blood-sucking Culicidæ has been directly developed from a short stout labium like that of *Mochlonyx*. The larvæ also approximate to the form found in *Culex* more closely than do the peculiar larvæ of *Corethra*.

EXPLANATION OF PLATE IV.

Fig. 53.—Labium of *Conicera atra* Mg. ♂. Seen from the ventral side, to show the mentum.

,, 54.—Trophi of *Gymnophora arcuata* Mg. Seen from the dorsal side. The armature appears to be the same in both sexes in this genus.

,, 55.—Hypopharynx of *G. arcuata*.

,, 56.—Dissection of the mouth of *Olivicra lateralis* F. The paraglossæ, the mentum, in fact all the labium, with the containing membrane supporting the palpi, have been removed. To show the process at the base of the labrum and the connection with the submentum, also the degeneration of the pharynx.

,, 57.—Dissection of the labrum of *Myiospila meditabunda* F. The stipites bearing remnants of maxillary palpi articulate on to the sides of the labrum, which is highly developed. Compare with fig. 61.

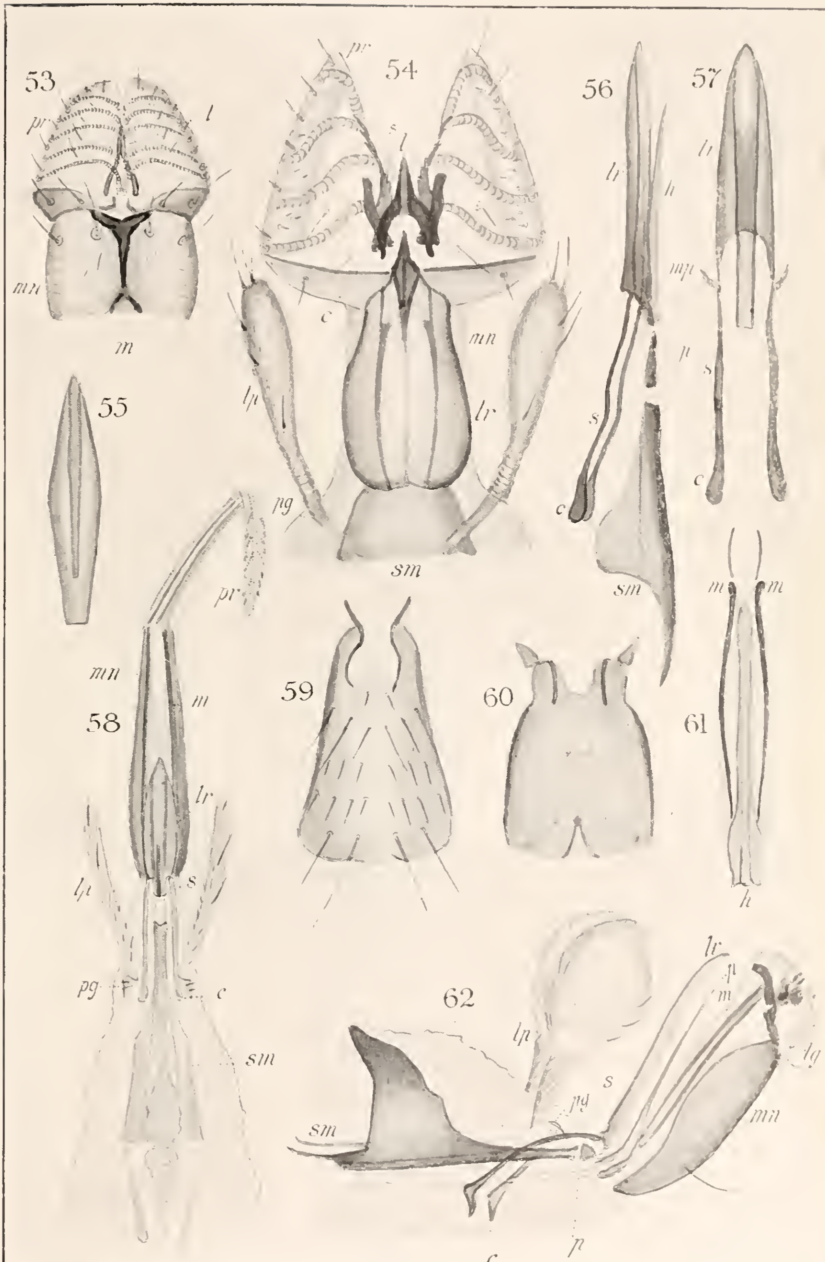
,, 58.—Trophi of *Siphona geniculata* Deg. Dorsal view; to show the Muscid trophi specialised for flower feeding, and the adaptation of the submentum into a sucking organ (?). The degenerating labrum and weak stipites may also be noted.

,, 59.—Mentum of *Musca corvina* F. To show the absence of the median suture.

,, 60.—Mentum of *M. meditabunda*. To show the same.

,, 61.—The hypopharynx and the plate on the dorsal side of the labium in *M. meditabunda*. The hypopharynx is in a very weak condition compared with the labrum. The lateral rods are the imbedded mandibles.

,, 62.—Trophi of *Lispe tentaculata* Deg. Lateral view. The dark mass in the paraglossæ are the teeth, which are very strong. The hypopharynx is thickened at the base and pierced by the pharynx, but the labrum is also used as a suctorial organ, and communicates with a tube leading through the submentum.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In the head, at the back of the submentum of some Psychodidæ and also of *U. fuliginosa* is an appearance suggesting the presence of the pharyngeal pump. If this is so, it would be of the type found in *Tipula*.

To this group must be transferred the Lonchopteridæ, as fresh dissections have revealed the laciniæ of atrophying maxillæ at the bases of the palpi. These laciniæ are 85 μ or $\frac{1}{300}$ in. long, and I must plead as excuse that it is as easy to overlook as it is difficult to dissect objects of this size (plate I. fig. 17). The paraglossæ are deeply cleft, and, like *Leptis scolopacca* L., have plates from which the tracheæ spring, on the edges of the clefts. The mandibles are imbedded in the mentum. The trophi of *L. flavicauda* Mg. and *L. scolopacea* are remarkably close to each other both in detail and general plan (plate I. figs. 15, 16, 18).

The mouth-parts of the Platypezidæ also resemble those of *Leptis*. In *Callimyia speciosa* Mg. the maxillæ are rather broad, but the cardines and stipites are in an atrophying state; the paraglossæ are of similar type to that found in *Leptis scolopacea* L. and *Lonchoptera flavicauda*; the tracheæ are more abundant than in *Leptis*, spring from plates, and the mandibles are imbedded on the ventral side. The paraglossæ in *P. consobrina* Ztt. are also of the same type, but the cardines and stipites are quite aborted, while in *P. fasciata* Mg. they are represented by thin rods, the palpi being very similar to those of *P. consobrina*. In other respects as regards the tracheæ, the mentum, the hypopharynx, and the labrum, the two last named species are very close to each other (plate II. figs. 27–30).

All the Bombylidæ* I have examined show the mandibles on the ventral side; alone in this group the Syrphidæ have them imbedded on the dorsal side, whence they may easily be dissected out in such large forms as *Erystalis* or *Helophilus*.

Group 3.—I have already alluded to the "pharyngeal pump" in *Tipula oleracea* L. In this insect it is formed of two plates and is close to the form found in *Culex*. I have also found it in the heads of *Ptychoptera albimana* F., *P. contaminata* L., *P. lacustris* Mg., *Gynoplistia bella* West., and several undetermined species, but it appears to be absent in the Chironomyidæ (plate II. figs. 22–24).

In the Ptychopteridæ mentioned above, the tracheæ of the paraglossæ spring from chitinous plates, in a similar manner to that already noticed in some Leptidæ and Lonchopteridæ, and the median cleft of the labium is deep. The venation of the Ptychopteridæ suggests that this family is one of the oldest in Diptera, and the deeply cleft labium is quite consistent with this hypothesis. The plate at the base of the tracheæ is more frequently found in

* *Anthrax paniscus* Rossi appears to lack the median structure, but appears to have the mentum bent in or furrowed in the median line; but I have not had sufficient material to be quite certain.

the families of the Brachycera, but is now seen to be a Nematocérous character, and affords valuable evidence of affinity.

In all the Stratiomyidæ that I have examined, the mandibles are fused in the median line of the mentum, and often send out lateral processes at the posterior end. *Michrochrysa polita* L., and *Chloromyia formosa* Scop., have plates at the bases of the tracheæ similar to those referred to above (plate II. figs. 25, 26).

The trophi in the Conopodæ are of a highly specialised type, and fitted for flower feeding. They are mostly analogous in structure to *Prosena* in the Muscidæ; that is to say, the mentum has displaced all the membranous parts of the labium, and has developed into a long styliform plate with the sides bent upwards, and fused with the mandibles at the upper edges. Of this type are *Conops quadrifasciata* Deg., *C. flavipes* L., and *Physocephala rufipes* F.

Zodion cinereum F. has the palpi more developed, and the paraglossæ are lengthened, and geniculated at the base; *Myopa buccata* L. has the palpi even more developed than in *Z. cinereum*, and the paraglossæ bearing well-marked tracheæ. These last two species have analogies in the Muscidæ in *Siphona*, and the trophi of the Conopodæ present, when compared with *Prosena* and *Siphona*, excellent examples of parallel development. The mandibles in this family are very obvious on the dorsal side of the labium, and the maxillary palpi, found in interesting stages of degeneration, show the relationship to the Syrphidæ.

Group 4.—The presence of the pharyngeal pump in the heads of many Dolichopodidæ is one more peculiarity in this family, already remarkable for its numerous peculiarities; it is also a character that helps the solution of the problem as to their phylogeny (plate II. fig. 31).

The pump is connected with the base of the hypopharynx and approximates to the mechanism found in the Empidæ, but differs in detail. The piston working in the cavity is a plate with the sides bent to the shape of a bulb, connected with the pharynx at its posterior end; there are also openings on either the upper or lower wall. When the bulb is drawn back by the pharynx, this opening is closed by the roof or floor of the outer case, and the bulb acts as a piston creating a vacuum, and when released, the opening being no longer obstructed, permits the free flow of fluid up the pharynx. Preparations of the following species show the pharyngeal pump:—

Dolichopus plumipes Scop.
D. griseipennis Stan.
Pœcilobothrus nobilitatus L.
Orthochile nigrocœrulea Ltr.

Porphyrops graripes W.
Argyra argyria Mg.
Medeterus truncorum Mg.
Aphrosylus raptor Hal.
Chrysotus laesus W. (?)
Psilopus wiedemanni Fln.
Campsicnemus scambus and *C. curvipes* Fln.
Machærium maritimæ Hal.
Hydrophorus litoreus Fln.

The trophi of *Aphrosylus raptor* Hal. are like the limbs, highly specialised for the attack of other insects, but they are also of great interest from the anatomical point of view. The most remarkable part is the labium, which is without the usual tracheæ; the mentum is but little developed, and lacks the median process that is found so constantly on this part in the Dolichopodidæ; nevertheless, the mandibles are imbedded, as dissection reveals two broad blades in the muscles of the ventral side; an interesting confirmation of my theory as to the migrations of this part. It can now be seen that *Aphrosylus* has halted in a stage of development, which such genera as *Dolichopus* and *Pœcilobothrus* must necessarily have passed through. The dorsal sides of the labium show the levers which are homologised as cardines and stipites in *Dolichopus,* but half-way up there is a thickening of the chitin which suggests the junction of the stipites and laciniæ: if this is the case it indicates another arrest of development. The palpi are flat and thinly haired, the hypopharynx is narrower than in *Dolichopus*; the labrum is formed into two large curved hooks, and the portion between these hooks is very strongly and shortly haired. Like the same part in *D. griscipennis* figured in the 1904 paper, the back of the labrum is drawn out into a powerful lever to which are attached muscles to work the labrum as an offensive weapon (plate II. figs. 33–37). In *Gymnopternus assimilis* Staeg. there is a type of trophi intermediate between *Dolichopus* and *Orthochile*; the labium, while retaining most of the characters of *Dolichopus,* being lengthened. This seems to indicate a change of habit in favour of flower feeding, and this idea is confirmed by the contents of the stomach, which is full of pollen (plate II. fig. 32).

Psilopus wiedemanni Fln. departs in the tracheæ of the paraglossæ from the usual curious type in the family, but still retains traces, and keeps the barbed labrum and ventrally imbedded mandibles, nearly always found in the Dolichopodidæ.

I shall devote considerable attention to the Phoridæ, as very little work has been done on the trophi, and owing to many peculiarities, the position of the family in the systematic lists is a matter of debate, on which the character of the mouth-parts throws light. The small size of these flies renders dissection very difficult, and a study of a greater number of species has shown that several points in the 1904 paper are erroneous, or erroneous in part.

The cardines are not in their usual place, but are aborted. I was misled by my preparation, which quite agrees with the figure on plate vii. (1904). What are marked as cardines are in reality the edges of the submentum. This shows when the structures are teased apart; mounted in the ordinary way the appearance is deceitful. The taste-hair at the end of each trachea is found in many of the trophi of Diptera, but, so far as my observations go, is never so large as it is in the Phoridæ and Dolichopodidæ. The part marked *h* (hypopharynx) is not that, but a fusion of the laciniæ, only to be found in the Phoridæ, and characteristic of their mouth-parts.

The trophi are peculiar in many respects, and present singularities not found in other families:—

1. The armature differs in the sexes in the majority of cases, though the genus *Gymnophora* appears to be an exception. This difference is not a failure of mandibles as in *Culex* or *Tabanus*, but the labrum is armed and the bases of the tracheæ bear strong teeth in the female, while the labrum is quite simple and the teeth less developed in the male (plate III. figs. 47, 48).

2. In both sexes (though often smaller in the males) is found the curious aculeation at the base of the cleft of the paraglossæ. This I homologise as the fused laciniæ, the cardines being quite aborted or absorbed into the base of the laciniæ. In *Gymnophora arcuata* Mg. and in the female of *P. curvinervis* Beck, the cardines appear to be present, but abnormally small and quite close to the laciniæ; their broadened bases are quite recognisable. I know of no similar migration of the parts in any insect, but a comparison with what has come about in the Tipulidæ and Dolichopodidæ makes me feel confident of this determination (plate III. figs. 38, and plate IV. fig. 54)

3. The cleft between the paraglossæ is very deep, and the edges of the paraglossæ bordering the cleft, bear chitinous plates.

4. The mandibles are fused into the mentum and send out lateral processes as in many Stratiomyidæ and Lonchopteridæ. (plate III. fig. 49, and plate IV. fig. 53).

5. The presence of teeth on the paraglossæ, only found in the specialised Muscidæ, combined with the anterior position of the maxillæ, and the ventral position of the mandibles, makes this trophi peculiar (plate III. figs. 38, 45, and plate IV. fig. 54).

6. The palpi are two-jointed in exceptional cases, as in *Phora concinna* Mg. figured on plate vii. (1904), also in *P. trinervis* Beck ♀; but in the majority of species they have annulated bases very similar to the same part in *Pipunculus*. They are labial and

bear more or less developed sense-organs. In *Trineura aterrima* F. this sense-organ is similar to that on the four-jointed palpus in some of the Bibionidæ (plate III. figs. 42, 46, 51).

The relationship to the Dolichopodidæ is shown not only by the toothed labrum and its greater development, but also by a pubescence on this part, that being a character mostly confined to the Dolichopodidæ; the deep channelled hypopharynx especially when viewed from the side is also similar to that found in some genera of the larger family. The hairs laterally placed on each side of the median suture of the mentum in some Dolichopodidæ, Lonchopteridæ, and Phoridæ also point to a relationship. The deeply cleft labium, the plates, the arrangement of the tracheæ and taste-hairs on the paraglossæ also indicate an affinity to *Leptis*.

The predaceous habits of the Phoridæ have been alluded to as probable, and I have now some evidence in support of that view. I have a small Acalyptrate Muscid which I took out of the grasp of *P. concinna;* both are mounted on the same card. I have made inquiries and it seems that the observation is rare, as those who have studied this family, like Dr. J. H. Wood, who has paid great attention to it, have not had a similar experience. But the contents of the abdomen in many preparations strengthens me in my opinion, as they present the appearance found in blood-sucking and predatory insects, a subject to which I have of late paid some attention. Add to this the markedly predaceous character of the mouth-armature, and it can be seen that these minute insects can find weaker organisms to prey on. Packard says, probably deriving his information from Williston, that different species feed on both living and dead insects and sometimes decaying vegetable matter*—and this is possibly an observation of the North American species.

Group 5.—The list of species in which the remains of palpi have been found contains two wrong determinations: *Myiocera carinifrons* Fln. is *Phorocera serriventris* Rnd., and *Anthomyia sulciventris* Ztt. is *Phorbia ignota* Rnd. These remnants of palpi occur so often that it is not necessary to add to the list already published; it may, however, be pointed out (1) that they are most strongly marked in the Cyrtoneurinæ section of the Muscidæ and the Mydæinæ section of the Anthomyidæ; (2) and fail in specialised forms such as *Stomoxys, Glossina, Siphona, Prosena,* or *Drymia*; (3) and in those genera where the fourth longitudinal vein completely closes the cell and has left the margin; (4) or the teeth on the paraglossæ are much developed and the eyes are separated in the males (the Cænosinæ section of the Anthomyidæ, and the Cordyluridæ).

* Entomology for Beginners. New York: Holt and Co., 3rd ed., 1899, p. 126.

As already stated, the Lonchopteridæ have been transferred to Group 2.

I am rather doubtful as to the position of the Pipunculidæ in this section. A dissection of *P. campestris* Ltr. ♀ shows the cardines of the maxillæ in contact with the bases of the palpi; while the preparation of *P. zonatus* Ztt., from which the 1904 drawing was made, and also two of *Chalurus spurius* Fln., show the bases of the palpi quite away from the cardines.

On the other hand, while *P. campestris* shows no suture on the mentum indicative of the fusion of the mandibles on the ventral side, it is very apparent in an undetermined female, in *P. modestus* ♀, and in *C. spurius* ♂.

The very marked sense-organ in the annulated palpi is also another Nematocerous character which makes the position of this family in the Cyclorrapha doubtful.

In *Echinomyia fera* L. several *Sarcophaga*, *Clistia mærens* Mg., *Olivicra lateralis* F., *Prosena sybarita* F., and *Siphona geniculata* Deg., there is a chitinous process at the base of the labrum. This on a cursory examination might appear to be a remnant of the pump in *Culex*; but a more careful inspection will show that it cannot be this, as it is not in connection with the pharynx, which shows as a small tube leading from the hypopharynx and passes under the process in a very degenerate state compared with the Brachycerous forms or with such conditions as exist in *Calliphora* or the Cordyluridæ. The process in the genera mentioned is connected with the other chitinous parts by flexible membranes and proceeds to the submentum, which is narrowed into a funnel for the reception of the duct, and incloses this "pseudopharynx" within its walls, where a process analogous with the pump seems to exist. This is fairly clear in *S. geniculata*, where there appears to be a valvular process inside the submentum (plate IV. fig. 58).

In *Stomoxys* and *Glossina* a somewhat similar arrangement exists, which clearly explains the degeneration of the hypopharynx in these genera.

In *Stomoxys* there is a strongly tracheated tube leading through the submentum, which is not modified as in *Siphona*.

The Anthomyid *Lispe tentaculata* Deg. has very large spatulate palpi, one of the most curious forms in the Muscidæ. The microscopic structure, when seen with high powers, appears identical with that found on the palpi of some Dolichopodidæ, particularly *Aphrosylus raptor* Hal., which also bears spatulate but not stalked palpi. The labrum in *Lispe* is used as a sucking organ and is connected with the submentum in the same manner as in *Siphona*, but the hypopharynx is also used; it is thickened at its base and pierced by the pharynx, which is fairly well developed. The strong teeth that are found on the paraglossæ show the relationship to the Cordyluridæ, and the position of the genus in the systematic lists endorses this; but this has come about by the consideration of another character, the wide separation of the eyes in both sexes. As the teeth are very strongly developed in all the Cænosinæ I have examined, there seems a correlation in the two characters (plate IV. fig. 62).

The processes on the labium of *Scoptera vibrans* L. described in 1904, have also been observed in *Pteropæctria nigrina* Mg. ♀, *Acidia lychnidis* F. ♂ and *Ceroxys pictus* Mg. ♂ ♀.

The very curious paraglossæ of *Scoptera* are noteworthy; the cleft in the median line has disappeared, and the paraglossæ are fused together. This suggests that the whole trophi are a late development, which does not help to any solution of the problem as to whence these processes are derived.

The very minute Chloropid, *Oscinis pusilla* Mg. which is but little over a millimetre in length, has very well marked remains of maxillary palpi, the ends of the stipites being thickly haired. An undetermined species of the same genus from New Zealand also has the same character. Other genera such as *Chlorops*, have in *C. tæniopus* Mg. the stipites with a very faint pubescence or as in *Meromyza*, *M. nigriventis* Mcq. and *M. lacta* Mg. quite bald.

As regards the Muscid family, these remnants when present can sometimes be seen with ⅔ in. objectives, but more often a ⅙ in. will be required with good substage illumination, for a satisfactory view.

Group 6.—In the Psilidæ, the trophi of *Loxocera albiseta* Schrank have been examined and dissected, and conform to the type of this group; the maxillæ resemble those of *Cœlopa frigida* figured in the 1904 paper, but have a chitinous process branching off at right angles from the middle of the stipes; a condition similar to that which I have found in some Ephydridæ.

L. albiseta has remarkably long antennæ, and is a fairly common insect, found stationary on herbage or hedges. It appears to feed on the juices of flowers, but I have no definite record of observations on this point.

Group 7.—In a number of *Hydrellia* that I collected at Geelong, Australia, I have found the complete maxilla, nearly exactly similar to that in *H. griseola* Fln. of our English fauna. These insects are very close to our form, and whether they have been introduced or not must remain an open question; but the observation is of interest as it implies the very possible wide distribution, characteristic of archaic forms, and agrees with the general character of the Australian fauna, which is often of ancient type. Since writing the above, I have mounted and examined a *Hydrellia* which I captured in New Zealand, and which also has similar maxillæ.

Group 8.—*Oncodes gibbosus* L., one of a genus in the Cyrtidæ, is without any mouth-parts, the buccal aperture being completely closed by a membrane; an abortion of parts has taken place, more complete than in *Gastrophilus equi* F., where remnants of palpi are still to be found. The failure of the mouth-parts is not a constant character in this family, the labium being long and much developed in some species of the genus *Cyrtus.*

Summary.

1. A few remarks are made on some points of anatomy in *Pulex irritans* L. bearing on its position in the Order.

2. An anatomical character in the mouth-parts is noticed which appears to divide the two great divisions in Diptera, the Orthorrapha from the Cyclorrapha.

3. The "pharyngeal pump" in the head of *Culex* is figured, and its homologues, found in the Tipulidæ, Asilidæ, Empidæ, and Dolichopodidæ, are figured and described in several species.

4. An atrophying fourth joint on the palpi of the female of *Culex annulipes* Mg. is figured and described.

5. The trophi in the Leptidæ, Lonchopteridæ, Dolichopodidæ, Phoridæ, and Conopodæ, are further discussed, and more species are figured in all these families, except the Lonchopteridæ and Conopodæ.

6. The Platypezidæ are placed in Group 2, and the trophi of several species figured and described. The Psilidæ are placed in Group 6.

7. The Lonchopteridæ are transferred to Group 2.

8. Mistakes in the homologies of the trophi of the Phoridæ are pointed out, and the species figured in 1904 is determined. Some evidence is given as to the predaceous habit in this family.

9. Two wrong determinations are pointed out in Group 5.

10. Remarks are made on the trophi of the Pipunculidæ and their doubtful position and varying armature.

11. Changes in the pharynx of some Muscidæ are pointed out, and the degeneration of the hypopharynx in some species accounted for; several dissections are figured.

In conclusion I have to express my many obligations to Mr. E. E. Austen, Lt.-Colonel Bingham,* Mr. J. J. F. X. King, Dr. J. H. Wood and Lt.-Colonel Yerbury, not only for much kind help in determination, but also for the provision of material for dissection.

* Since the above was written, Colonel Bingham, to the deep regret of all who knew him, has gone to his rest.

11.—*Note on a New Growing Cell for Critical Observations under the Highest Powers.*

By A. A. C. Eliot Merlin.

(*Read November* 18, 1908.)

Having at various times done a considerable amount of high-power work on living bacteria and the smaller monad forms, it was found that for critical observational purposes, under even oil-immersion objectives, a well-constructed Rousselet live-box as usually made afforded perfectly satisfactory results except that the thin water film containing the specimens was certain to quickly evaporate, so that in the hot summer months any individual organism could only be studied for about half an hour. To obviate this very serious drawback, a modified live-box was made for, and described by me,* in which evaporation was retarded by means of an india-rubber band placed round the rim.

I now venture to bring to your notice an improved form of moist and warm chamber box which has been found in practice to work most satisfactorily, a very small and excessively thin film having remained unaffected by evaporation during three weeks in the hottest summer weather, the thermometer standing at well over 80° F.

The accompanying illustration (fig. 1) will explain the design of this little piece of apparatus more clearly than any verbal description, the appliance consisting of a closed rectangular warm-water circulating tank 3·5 in. long, 2 in. wide, and 0·6 in. deep. In the centre there is a circular well 1·6 in. in diameter, with a glass tablet, 0·4 in. in diameter, mounted flush with the under surface of the tank. The cover-glass carrier is as in the Rousselet model, except that it is provided with a flange, 0·3 in. broad, which rests on another flange on the upper surface of the rectangular tank, so that when the $\frac{7}{8}$ in. cover is in position close over the tablet,† there is just space for a ring of thick blotting paper or linen to lie in position between the flanges. The blotting paper

* Journ. Quekett Micr. Club, series 2, ix. (1905), p. 169.

† Although this contrivance is more especially designed and intended for the observation of small monad forms under high powers, for which a very thin water film is desirable, it will be found that, by placing two or more blotting-paper rings between the flanges, the depth of the cell can be sufficiently increased to accommodate the larger organisms, such as rotifers, etc., without subjecting them to injurious pressure.

or linen ring is cut with two projecting pieces, one on each side, these passing into two little wells sunk into each end of the tank, so that the paper or linen can be kept constantly and evenly wet, and thus air entering the chamber can only do so by passing through the saturated material between the flanges.

Mr. C. Lees Curties has kindly consented to exhibit and explain a box constructed by his firm to my specification.

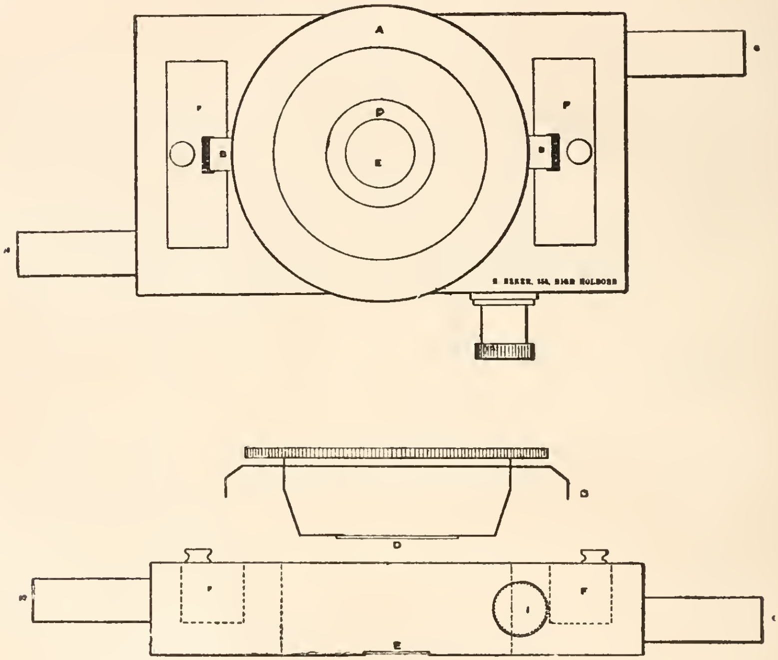

Fig. 1.

A. Cover-glass carrier.
B. Filter-paper, blotting-paper, or linen.
D. Cover-glass.
E. Glass tablet.
F. Reservoirs.
G. Inlet for warm water.
H. Outlet for warm water.
I. Opening for thermometer.

To sum up, the chief points and advantages of the contrivance are:—

1. A minute living monad or bacillus can be kept under continuous observation with a $\frac{1}{12}$ oil-immersion objective and critical illumination for an indefinite period.

2. The oil may be wiped off from the cover and a dry lens substituted without disturbing the living specimens under observation.

3. When warm water from a thermostatic regulator is allowed to circulate through the tank (to which a thermometer can be adapted), living organisms can be kept for long periods at a given temperature. In this case the metal under-part of the tank should not rest on the Microscope stage, but two thin strips of ebonite or other suitable non-conducting material should be inserted between the box and the stage.

4. The apparatus must be so constructed as to be absolutely air-tight except where the moist air enters at the flanges, and any cement used should be capable of withstanding the effects of moisture, cedar-wood oil, and the temperature of a sterilizing oven when it may be advisable to sterilize the contrivance before use.

5. The cover-glass carrier is arranged so as to allow a very considerable volume of moist air to be contained within the chamber, this being necessary for the well-being of living organisms.

6. The tablet should be small, and must permit of an oil-immersion or any other objective being used up to its margin. Its thickness must allow a wide-angled aplanatic substage condenser to be conveniently focused through it.

7. The wells are provided with covers to retard evaporation when necessary, but they can be easily replenished with water when the apparatus is in action on the stage of the Microscope.

In conclusion, I am greatly indebted to Mr. C. Lees Curties for the care he has bestowed on the construction of this little contrivance, which is, so far as I know, the only moist chamber yet devised which permits of the continuous and convenient observation of the smallest living organisms under critical conditions with the highest powers.

III.—*A Workshop Microscope.*

By J. E. Stead, F.R.S.

(Read December 16, 1908.)

The Microscope exhibited at this Meeting has not any special novelty beyond the illuminating device. It was designed by myself, and made by Messrs. Swift and Son, for the use of engineers and workers in metals, who occasionally require the use

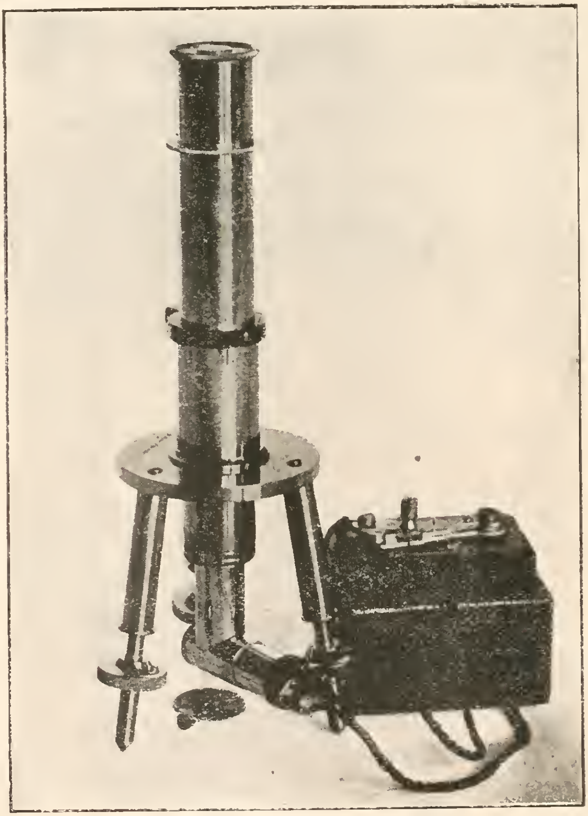

Fig. 2.

of a Microscope in the most simple form in their workshops. As the metal objects are opaque, the necessity of having a substage is avoided.

The stand, as will be seen in the illustration (fig. 2), has no substage, and is supported on a tripod base.

The lower terminals of the legs consist of hard steel points, and the upper ends are secured by screws into the brass disk.

The microscopic tube, 8 in. in length, is free to slide through a second tube secured in the centre of the disk, and when in use focus is obtained by moving the tube upwards and downwards by the fingers. When the focus is found, the tube can be fixed, if desired, by a small set-screw.

Such a Microscope cannot replace the more elaborate Microscopes, and is designed, as previously stated, for use in the workshop and office of the works foremen.

The illuminating arrangement can, however, be used in conjunction with any Microscope.

IV.—*A Simple Method of Illuminating Opaque Objects.*

By J. E. Stead, F.R.S.

(*Read December* 16, 1908.)

The main difficulty in illuminating opaque objects, where the illuminant is independent of the Microscope, is in making the adjustments so as to obtain maximum illumination. By the use of the illuminating device described below, this objection is quite overcome.

The illustrations (figs. 3 and 4) show with clearness the simple system in which the illuminating source and the reflectors are attached to the object-glasses.

In the arrangement shown in fig. 3—suitable for 1½ objectives —the cover-glass reflector is placed between the nose of the glass itself and the object, and is supported in position on a right-angle tube, one limb of which is attached to the object-glass; into the

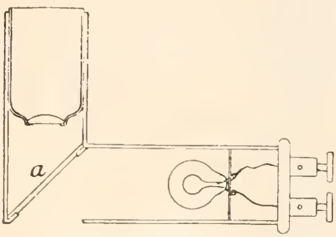

Fig. 3.

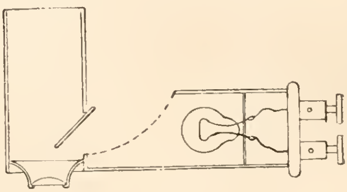

Fig. 4.

other is fixed a small electric lamp, which can be switched on when the Microscope is in use.

Fig. 5 is an improvement of fig. 3, and is so arranged that either vertical or oblique rays of light can be thrown on the sections. This is effected by a device in which the tube carrying the lamp and reflector can be moved to the right or left, in such a way that when in one position vertical rays fall on the object, and when in the other position, oblique rays.

The illustrations are sufficiently clear to show this.

When applied to ordinary Microscopes there is no necessity to keep the Microscope in any one position when the operator is at work, and it can be tilted to any angle without the slightest disadvantage.

For low-power work, it has been found by long experience that the simple cover-glass reflector is all that is required, but more perfect illumination can be obtained by replacing the plain cover-glass by a silver mirror, so adjusted as to only partly cover the object, as in the Sorby-Beck reflectors.

For higher powers the reflector is always placed in a slit in the object-glass, and the electric lamp is attached to the object-glass in such a position that, when the current is turned on to the lamp, the object is invariably perfectly illuminated. Fig. 4 will explain the arrangement.

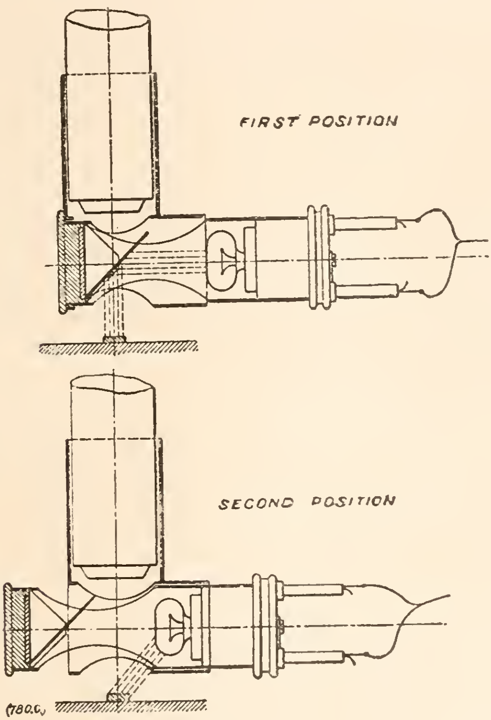

Fig. 5.

V.—*On Mounting Rotifers and Protista in Canada Balsam.*

By The Rev. Eustace Tozer.

(*Read December* 16, 1908.)

Some years ago, when experimenting with cell-life, it occurred to me that if delicate organisms like Rotifers and *Protista* could be passed through oils, mounting in Canada balsam would follow as a matter of course. I found that they could be prepared for oil by passing through absolute alcohol after being fixed and hardened. I now use various fixatives: osmic acid 1 p.c., picric acid, glacial acetic acid, absolute alcohol, formalin 40 p.c.

In February 1908 I exhibited at the Society's Meeting some Rotifers prepared and mounted in balsam by methods I will describe.

I have brought a series of slides to exhibit to-night, including *Brachionus* (infested with Sporozoa), *Hydatina, Floscularia, Œcistes stygis* (extended from tube, and showing wreath of cilia), *Pterodina, Euglena,* etc. They are double-stained and without shrinkage.

I may say that the methods are exceedingly simple, and within easy reach of the average worker.

The Methods.—To get Rotifers in quantities I placed them in shallow saucers covered with glass, away from direct sunlight. Clean pond-water is best, and I put in *Euglena* for food. Success depends upon a good supply of food. They breed rapidly, and may be picked off the surface of the water with a penknife.

Extending and Fixing.—One drop of osmic let fall on the water on the slide suffices for many. This acid is essential for *Acineta* and *Actinophrys* to fix the rods.

Three drops of cocaine 10 p.c. added at intervals will answer for many Rotifers. Others are amenable to picric acid added at intervals.

Picric acid or cocaine fixes pseudopodia of amœbæ.

Formalin added slowly extends the jaws of small sea-worms. Formalin vapour, manipulated with watch-glasses, is the best fixative for flagellate zoospores and the monads of infusions.

Glacial acetic acid differentiates the jaw-parts of Rotifers, revealing the most minute structure. It is particularly useful for the study of kinetic phenomena in Rotifer eggs. The Rotifers may be left in it for eight hours before passing through the other processes to be described. The only drawback is that unless carefully applied it shrivels the cilia. (Glacial acetic acid must be first washed out with alcohol.)

When the Rotifers are transferred to the slide—extended and fixed by osmic, cocaine, or picric—I put on the cover-glass, placing a thread of white cotton between the cover-glass and slide, thus—

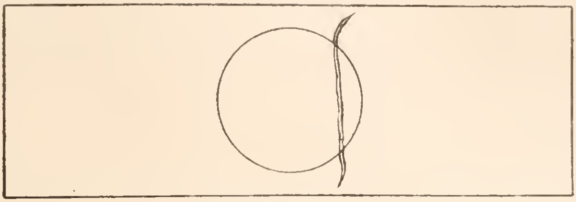

FIG. 6.

The cotton prevents the specimens from being crushed or washed away in subsequent operations, and enables us to pass them through all kinds of treatment.

I now draw off the water by placing bits of blotting-paper to the right of the cotton-thread, and apply osmic at the left of the cover-glass.

When the specimens are immersed in the osmic, add the stain, picro-carmin or eosin. These two stains prevent osmic from blackening, and the picro-carmin along with osmic differentiates the structure. Staining and hardening are thus combined.

The slide is then put in a dark moist chamber, to prevent evaporation. I use two saucers. In the lower one I put some water, and over it a square piece of glass. The slide goes on the glass, and the whole is covered with the other saucer, which is moistened.

Time required for hardening varies with different forms. *Brachionus* will be ready for further treatment in 5 hours; *Hydatina*, 12–24 hours; *Œcistes*, 24 hours; *Floscularia* (whose case is so difficult to fix), 3 days; amœbæ and other allied forms, about 10 hours (the latter with picric method).

When hardening is complete, the specimens must be washed. Blotting-paper is applied to the right of the cotton, and drops of water to the left side of the cover-glass. After all the osmic and stain are washed out from under the cover-glass, leave the specimens in the water some fifteen minutes. I often counter-stain here with eosin, which expels acid. Now thoroughly dehydrate with absolute alcohol, applying drops and blotting-paper. After thoroughly washing with this alcohol, leave the specimens in it for at least one hour, to clear all trace of acid. Any acid present causes shrinkage when oil is applied.

I next apply oil of cloves, the worst possible oil for many things, but excellent for Rotifers and *Protista* prepared as described. The oil is applied in the same way as the water and alcohol. I leave the specimens in the oil for half-an-hour. As this oil does not evaporate, the cover-glass may be lifted and the specimen adjusted. Tilt the slide and allow the superfluous oil to run off. Drop on the smallest quantity of xylol, and then add the balsam (xylol-balsam). Leave it a few minutes and apply a warmed cover-glass.

If the specimen will admit of it, lift it on to a clean cover-glass with a brush. Apply the xylol and balsam. Lower a slide down on to the balsam, and turn over. It is always better to mount on the cover-glass for research with immersion lenses.

When cocaine is used, pass osmic through and treat as described. *Floscularia* will require three days in the osmic and stain. When picric acid is used, leave the forms in it for a while and add picro-carmin.

Protista require about 8 hours in the moist chamber; 24 hours are generally necessary to exhibit the cilium.

Before washing with water, when picric is used, pass under the cover-glass a few drops of osmic. Then proceed with water, then alcohol, and then oil as described.

For *Euglena* I use formalin, picric, or osmic to fix and harden, 5 to 10 hours. Osmic alone preserves the natural colour of many *Euglenæ* and Diatoms.

For the Study of Cell-division in Diatoms.—The following method not only fixes the cell contents, but emphasizes the beautiful markings. The diatoms are put into a watch-glass in sea-water or fresh-water, according to their habitat. Place a small piece of wet cotton near the edge, move the watch-glass round, and the diatoms gather at the bottom. Slowly tilt the watch-glass to pour off the liquid, helping it away with blotting-paper. The cotton prevents the escape of specimens.

Now fix with abundance of picric acid or osmic, add picro-carmin, cover with another watch-glass, and leave in the dark for ten hours. Then pour off the picric as before, by tilting and blotting-paper. Add water, and pour off again. This is repeated until no colour is given off. Go through the same process with absolute alcohol.

When no colour is given off, leave the specimens in the alcohol some hours, covering with a watch-glass, which will prevent rapid evaporation. Dip a brush now in the watch-glass, lift a few specimens, and transfer to oil of cloves on a slide. If they clear, the rest of the specimens are ready. When that is so, pour off the alcohol and add oil of cloves.

Leave the specimens in the oil for a while, and lift out as required with a brush on to a cover-glass. Drop on them the smallest quantity of xylol, then drop on the balsam. Leave the cover-glass thus, protected from dust, for a while, then turn over the cover-glass on to a slide just moistened with xylol.

This method may be adapted to preparing quantities of Rotifers, and is very useful for the larger *Protista*. Minute *Protista* are prepared on the cover-glass. The cover-glass is smeared by a brush dipped into, let us say, a swarm of *Chlamydomonas.* Drop on a little osmic acid, and add picro-carmin. Leave it thus in the moist chamber for 24 to 48 hours. When taken out, allow the liquid to nearly evaporate until the cover-glass is seen to be just moist. Now turn over the cover-glass on to a slide, interposing the thread of cotton.

It will be found that most of the forms are fixed on to the cover-glass. Wash very gently with water, then alcohol, as described for Rotifers. Then follows the oil, and the cover-glass is lifted on to a drop of balsam on a clean slide. This method shows both structure and cilia.

Many very minute *Protista* may be mounted by the ordinary methods of preparing blood. The best fixative is formalin vapour. Moisten a cover-glass, and it will fix to a flat-shaped watch-glass. Turn this over on to a deep watch-glass containing formalin. Leave on a warm place for 15 minutes.

The specimens are fixed. They may be dried and stained as with the blood method, or, better, passed through the processes described for *Chlamydomonas.* For these processes they will require longer fixing.

A word on mounting *Hydra viridis* may be useful. Put the specimen on a slide in water with cover-glass and cotton. Let it extend naturally. Apply the smallest possible quantity of absolute alcohol, letting it reach the animal at its base, where it is least sensitive.

It will stretch and die. Dehydrate at once, and let it harden in absolute alcohol for an hour or so. Replace the alcohol with water to stain. Stain with picro-carmin 1 hour, counter-stain with Heidenhain's hæmatoxylin 15 to 30 minutes, wash, dehydrate, apply the oils, mount in balsam.

If in any of the above methods absolute alcohol should give any trouble, use the graded alcohols, 30 p.c., 60 p.c., then 90 p.c., then absolute.

The advantages of balsam mounts need scarcely to be stated; they allow the best methods of staining; when stained, the specimens exhibit structure more clearly than by any other methods. And then, of course, the mounts are permanent.

I would advise workers to experiment first with *Brachionus,* because of the firm envelope.

For extremely delicate forms I have recently tried with success the following method. After extending, hardening and washing as described above, I have put the specimens through a second process. I lift the specimens into a few drops of osmic and leave them 2 to 4 hours. Then I wash with water, dehydrate, add the oil, and then balsam.

VI.—*The "Red Snow" Plant* (*Sphærella nivalis*).

By G. S. West, M.A., D.Sc., F.L.S.

(*Read February* 17, 1909.)

The red coloration of extensive tracts of perpetual snow in alpine and arctic situations is caused by a small alga known as *Sphærella nivalis* Sommerf. It belongs to the sub-family Chlamydomonadeæ of the Volvocaceæ, and is very closely related to *S. lacustris* (Girod.) Wittr. (= *Hæmatococcus pluvialis* Flotow), the tiny alga which so often gives a red colour to drying-up rain-water pools and tanks.

It is in the resting stage of the alga that the red pigment is chiefly developed, and therefore the beautiful red coloration of the snow, which sometimes causes the admiration and astonishment of the traveller and explorer, is due to the presence of myriads of the resting-cells of *Sphærella nivalis.*

There are no authentic records of "red snow" in the British Islands due to this alga, and, owing to the peculiar physiological conditions necessary for the completion of its life-cycle, it is scarcely likely that it will be found. It occurs in the Austrian, Swiss, and Italian Alps, and in Norway, the red tinge appearing towards the month of August. It has also been found amid the perpetual snows of other regions, more especially in the South American Andes, and in the arctic and antarctic snow-fields.

It possibly occurs throughout most of the arctic snow-fields, and the present article was written on the examination of some particularly fine resting-cells recently presented to the Society by the Peary Arctic Club.

Each resting-cell is a small globular body (17–24 μ in diameter), consisting of a protoplast inclosed in a fairly thick wall of cellulose. Pyrenoids and a nucleus are present, but are hidden by a red pigment known as "hæmatochrom," which permeates the whole protoplasm, and exists partly in solution in minute drops of oil, and partly in a microcrystalline form. A small quantity of chlorophyll is also present, even in the purely red cells. The exact function of this hæmatochrom is a perplexing problem. It is certainly more stable than chlorophyll, and generally accompanies diminished vitality, which fact accounts for its presence in the resting-cells. The cells can thus probably exist through adverse circumstances much better than if they were merely green, not being so easily destroyed by sudden changes in light and temperature. Both Kny and Kerner have shown that red colouring matters are probably concerned in the conversion of light-rays into heat, and the great value of such a function to the "red snow" plant is at once obvious. Moreover, Hazen has pointed out that in the closely related *Sphærella lacustris*, more red pigment is habitually developed in cultures made from material collected from places frozen for a great part of the year, than in those made from material collected in milder climates.

The life-history of this organism is briefly as follows. The typical resting-cell forms four daughter-cells of a similar bright red colour, which remain for a time within the wall of the mother-cell. So long as unfavourable conditions supervene, these daughter-cells remain in the resting state, although often with a slight increase in size. Should the conditions become favourable, however, the daughter-cells very quickly escape from the mother-cell, develop a pair of cilia, and become motile. Each is now a zoogonidium (or asexual motile gonidium), and in this state the cell generally increases in size. The cell-wall is thin and distended, standing out from the main body of the protoplast; but much detailed observation is yet required on the motile state of *Sphærella nivalis*. After a longer or shorter active period, the zoogonidium returns to the resting state, and the main body of the protoplast develops around itself a thick wall within the delicate wall it possessed in the motile state. A sexual method of reproduction by the conjugation of isogamous planogametes ("microzoogonidia") has been described. The resulting zygospores are said by Wittrock to be verrucose at maturity.

Sphærella nivalis appears to have adapted itself to very low temperatures, but it does not stand alone in this respect. There are several algæ, belonging to widely separated groups, which live habitually in the snow, and form a small assemblage of plants known as the Cryoplankton.

Prolonged exposure to a low temperature is physiologically necessary for the "red snow" plant, otherwise it loses its vitality. Chodat has stated that this alga will not live for any lengthened period at a temperature above 4° C., but experiments conducted both in this country and the United States do not entirely support this statement, as the resting-cells can be kept alive in water for over twelve months at ordinary outside temperatures.

The distinctions between *Sphærella nivalis* and *S. lacustris* are not very great, and many authors have considered them to be specifically identical. The only difference of importance appears to be the presence in the motile vegetative cells of *S. lacustris* of protoplasmic threads connecting the central mass of the protoplast with the outstanding cell-wall, whereas in *S. nivalis* these threads are absent. Wollenweber states that *S. lacustris* has numerous contractile vacuoles which pulsate independently of one another, and that this is one of the chief distinguishing characters between *Sphærella* (*Hæmatococcus*) and *Chlamydomonas*. He agrees with Wille that *Sphærella nivalis* should be regarded as a species of *Chlamydomonas*, *C. nivalis*, but before this view can be definitely accepted the motile state of *Sphærella nivalis* requires a good deal of detailed investigation.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Oogenesis in Cat.‡—Hans von Winiwarter and G. Sainmoint find that the definitive ova are all formed after the fœtal period. All the medullary formations and all the ova and follicles of the primitive cortical layer disappear. The definitive ova arise either from non-differentiated cells of the second proliferation (tubes of Pflüger), or from cells of the third proliferation or epithelial invagination. This neo-formation is the only one that occurs in the course of the development of the ovary.

Origin of Primitive Germ-cells in Rana esculenta.§ — Sergius Kuschakewitsch finds that in a normal brood the primitive germ-cells arise from two sources. There are some of primary origin from modified yolk-cells ; there are others of secondary origin—from mesenchyme and cœlomic epithelium. In embryos which develop from late-fertilised eggs there is no stage of primary germ-cells, and the primordium of the gonad cannot become an ovary. It becomes a testis, and the spermatogonia appear directly from the genital strands.

Entrance of Dogfish Ovum into the Oviduct.‖—V. Widakowich discusses this question, and finds a solution in the alterations of pressure brought about by the changes in the hepatic venous sinus and tube-sinus which lies around the ostium abdominale tubarum and the beginning of the oviducts.

* The Society are not intended to be denoted by the editorial " we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Acad. R. Belg. Classe des Sci., 1908, No. 6, pp. 602 7.

§ SB. k. Akad. wiss. München, 1908, pp. 89-101 (11 figs.).

‖ Zeitschr. wiss. Zool., xci. (1908) pp. 640-58 (1 pl., 2 figs.).

Hyperdactylism in Houdan Fowls.*—Marie Kaufmann-Wolf gives a precise account of a large number of cases, devoting particular attention to the development. Among the general results of the investigation the following may be noted: (1) Hyperdactylism in fowls is a new departure not atavistic; (2) there are indications of mirror-symmetry in the hyperdactylous conditions; (3) the cause is endogenous, not extrinsic, e.g. not due to amnion-threads.

Fault-bars in Feathers.†—O. Riddle finds that fault-bars (weak areas interrupting the fundamental barring), are due to malnutrition. They may be produced by feeding birds on Sudan iii., by mechanical injury of the feather germs, by bad sanitation, parasites, etc., and by the use of amyl-nitrite to reduce blood-pressure. They are normally laid down at night, when blood-pressure is normally low. The structurally weakened areas tend to be less pigmented. "The reduced nutrition, brought about daily by the minimum blood-pressure; the disadvantageous position, in relation to the blood, of the pigment and barbule elements of the feather; together with the very rapid rate at which feathers grow, furnish the complex of conditions which bring unfailingly into existence a fault-bar, and to a more or less appreciable extent a light fundamental bar, at perfectly regular intervals in the entire length of every feather formation." "The melanin pigment of the feathers of birds shows, under favourable conditions, quantitative variations of the pigment produced in response to changes in the available food supply. This is an additional evidence that this pigment is not a derivative of hæmoglobin, but of the serum or cell proteids."

Hump-backed Trout.‡—James Ritchie discusses a case of abnormality—probably congenital—in a common trout (*Salmo fario*) which showed only 40 vertebræ instead of the usual 56 to 60. The segmentation of the body was normal as regards myotomes, neural spines, and hæmal spines, but the region of the centra was reduced as indicated. It is impossible to regard this reduction as due to pathological ankylosis.

The possibilities of interpretation seem to range themselves round two alternatives. 1. It may be that certain of the arcualia did not give rise to the usual skeletogenous tissue, within which the ossification of the centra proceeds, and that, therefore, certain of the potential centra never actually existed. That is to say, each of the abnormal internodes in the vertebral column of the specimen described is a true centrum to which one or two neural arches, properly belonging to missing centra, have become attached. The deficiency in the internodes would in this case be due to the actual absence of centra. 2. The alternative is that —the skeletogenous tissue of the future centra having been completely formed—a compression in certain regions took place, succeeded by continuous ossification, uninterrupted by nodes. That is to say, the abnormal internodes in the specimen contain the elements of as many centra as there are neural spines, but those elements have not had the opportunity of developing into separate centra.

* Morphol. Jahrb., xxxviii. (1908) pp. 471–531 (3 pls. and 42 figs.).
† Biol. Bull., xiv. (1908) pp. 328–70 (4 pls.). See also Amer. Nat., xlii. (1908) pp. 550–2.
‡ Ann. Scot. Nat. Hist., 1908, pp. 223–7 (1 pl.).

Race-crossing and Sex Ratio.* — Maud de Witt Pearl and Raymond Pearl discuss the widespread belief that hybrids show an excessive proportion of males, or, more generally, that the relative proportions of the sexes may be influenced by the method of breeding practised. Statistics of over 200,000 human births, extending over a period of ten years in the City of Buenos Ayres, show that the proportion of males to females is significantly greater when the parents are of different racial stocks than when they are of the same stock. The preponderance of males in the offspring of cross-matings does not appear to be capable of explanation as the result of environmental or demographic influences.

Geminate Species.†—David Starr Jordan gives instances of what he calls geminate species, which represent one another on opposite sides of some form of barrier. Good instances are found among the fishes on the two sides of the isthmus of Panama. Geminate species differ in minor regards, characters which we may safely suppose to be of later origin than the ordinary specific characters. "While segregation or isolation is not a force, and, perhaps, not strictly a cause in species formation, it is a factor which apparently can never be absent, if the species retains its independent existence."

Evolution without Isolation.‡—O. F. Cook does not think that isolation (or selection) causes evolution, or helps it along. The separation of a species into two or more parts allows the parts to become different, but there is every reason to believe that evolutionary changes of the same kind would take place if the species were not divided. Isolation is the shears that splits the species, not the loom that weaves it. The weaving is done when the fabric is broad. The larger and more diversified species make the truly constructive evolutionary progress. The evolution of a species is in no way dependent upon its being split into smaller groups, but is more likely to be hindered by narrow subdivisions. If the groups are too small they degenerate and become extinct, instead of continuing their evolution. Isolation, though making more species, impedes evolution.

b. Histology.

Leucocytes in Invertebrates.§— Max Kollmann has made an elaborate study of the leucocytes in representative types of Invertebrates. He discusses the various kinds, and in particular the development and role of granulated leucocytes. These accumulate reserve substances, and increase or decrease in number as the state of nutrition varies. The lymphoid organs found in various groups—molluscs, arthropods, annelids, echinoderms—resemble similar organs in Vertebrates, consisting essentially of stroma (usually cellular) with free lymphoid cells in its meshes.

* Biol. Bull., xv. (1908) pp. 194–205.
† Amer. Nat., xlii. (1908) pp. 73–80. ‡ Tom. cit., pp. 727–31.
§ Ann. Sci. Nat. (Zool.) viii. (1908) pp. 1–240 (2 pls., 25 figs.).

Structure of Pigment-cells.*—V. Franz has made a study of various types of pigment-cell. The concentration of the pigment depends on intracellular streaming movements of the pigment granules. The plasmic radial structure of pigment-cells has its basis in an intracellular skeleton, somewhat like that of some Acantharia.

Regeneration of Intestinal Epithelium in Cobitis fossilis.†—Hélène Lupu finds that the epithelial cells degenerate by the breaking down of the nuclei and dissolution of the chromatin. The regeneration occurs by superficial mitosis at the expense of persisting embryonic basal cells. There is no evidence of any passage of connective-tissue elements through the basal membrane.

Interstitial Tissue of Mammalian Ovary.‡—Hans von Winiwarter has studied this in man and other mammals. It probably occurs in all mammals. It appears periodically, as if in instalments, and probably has a trophic rôle. There is no warrant for speaking of an interstitial gland.

Regeneration of Peripheral Nerves.§—Ross G. Harrison cut the nerves of one side of the tail of larvæ of *Rana sylvatica* just beyond the point of emergence from between the myotomes, and observed the process of degeneration and regeneration from day to day. The degenerative processes take place very rapidly. In less than 24 hours the medullary sheath is completely disintegrated beyond the lesion, and for a very short distance central to it. In the axis-cylinder of both the medullated and non-medullated nerves, the signs of degeneration are less marked, but unmistakable. The Schwann-cells become less regularly spindle-shaped, with a somewhat humpy surface, and do not adhere so closely to the axis-cylinder.

After one or two days the cut ends of many of the nerves have united by a protoplasmic bridge. In such cases the degeneration of the peripheral part of the axis-cylinder is immediately arrested, indicating that a primary healing of nerve-fibres is possible. The medullary sheath is not rehabilitated immediately, and the process of re-formation of this structure resembles its initial development.

When the peripheral portion of a nerve fails to unite with a central stump, degeneration continues till the nerve disappears. When a central stump fails to unite with a peripheral end, regeneration takes place by a comparatively slow process in a centrifugal direction. There is no indication whatever of any power of "auto-regeneration" in the nerves whose connection with the central end remains severed.

c. General.

Habits of Sloths.‖—A. Menegaux points out that sloths (*Bradypus*) are not exclusively arboreal—that they sometimes descend to the ground and seek out another tree. They descend backwards. They

* Biol. Centralbl., xxviii. (1908) pp. 545–8 (13 figs.).
† Arch. Zool. Expér., ix. (1908) pp. 417–28 (1 pl.).
‡ Anat. Anzeig., xxxiii. (1908) pp. 1–9 (5 figs.).
§ Reprint from Amer. Journ. Anat., vii. (Feb. 29, 1908) 1 p.
‖ Comptes Rendus, cxlvii. (1908) pp. 1079–82.

bite off the leaves they eat, and never put their hands to their mouths. Although they move about on the branches back downwards, they do not sleep in this position.

Theory of Pentadactyl Limb.*—A. N. Sewertzoff has studied the development of the limb in a number of reptiles and amphibians, such as *Ascalobotes fascicularis* and *Triton cristatus*, and has been led to the conclusion that the pentadactyl limb may be traced back to a broad horizontal fin attached by a broad base to the lateral body wall.

Relation of Size and Structure of Intestine to Diet.†—P. Revilliod finds that the average relation of length of intestine to length of body in the adult rat is 6 : 1 ; this ratio is affected by age, sex, and diet ; in 25 males it was 5·77 : 1 ; in 20 females 6·2 : 1 ; in the new-born the ratio is 4·17 : 1 ; at one month it is 6·49 : 1 ; at three months 6 : 1.

The form of the villi changes in the first two months from cylindrical to high and narrow, and then to broad and semilunar. Vegetable food has a mechanical influence on length, resulting in slight elongation. Animal food has a chemical influence on length, resulting in great elongation. With a milk diet the intestine is reduced in diameter and length, and the villi have a form similar to that seen during lactation.

The short intestine of Carnivores is the result of a very slow functional adaptation. The long intestine of Herbivores is due to the permanent mechanical effect of the insoluble residue of the food.

Hæmoglobins of various Vertebrates.‡—E. T. Reichert and A. P. Brown find that the crystals of hæmoglobin, from species of *Felis*. are quite different from those of *Canis*. There is even specificity in the hæmoglobin-crystals of a species, e.g. difference in the angles. In some species the oxyhæmoglobin is dimorphic, or even trimorphic. This is an interesting contribution to the conception of chemical specificity.

Labyrinth of the Ear.§—Albert A. Gray continues his careful study of the structure of the labyrinth in Vertebrates. He gives an account of the membranous labyrinth of the monitor, the emu, the rhea, the penguin, the echidna, and discusses the relationships of the aqueduct of the perilymph, the perilymph recess, and the round window to one another, and to the cochlea, and shows how the last stage—in Primates—may have been reached from the Reptilian condition.

Moulting in Lizards.‖—H. L. Brunner has studied the mechanism of moulting in the head of lizards. The veins and blood sinuses of the head are concerned. Special muscles distend the sinuses and raise the venous blood-pressure. One of these muscles (m. constrictor venæ jugularis internæ), invests the jugular where it passes from the head into the neck ; a second (m. protrusor oculi), lies behind the orbit, in close relation to the large orbital sinus. During the moulting the

* Bull. Soc. Imp. Moscow (1907) pp. 1–430 (6 pls.).
† Rev. Suisse Zool., xvi. (1908) pp. 241–319 (1 pl.).
‡ Proc. Amer. Phil. Soc., xlvii. (1908) pp. 298–301.
§ Proc. Roy. Soc., Series B, lxxx., No. B 543 (1908) pp. 507–28 (2 pls.).
‖ Proc. Indiana Acad., 1907 (published 1908) p. 61.

number of heart-beats increases and a larger amount of blood is sent to the head.

In the first stage the constrictor contracts, the heart-beat is accelerated, the veins and sinuses are distended, the eyes protrude. In the second stage the protrusor contracts, along with others which press upon the distended vessels, raising the blood-pressure still more. The distension of vessels and elevation of blood-pressure, aid in exuviation by stretching the skin and by facilitating the processes of metabolism. The moulting mechanism may be set in motion experimentally by applying court plaster to the head. In snakes and turtles the protrusor oculi is wanting.

Skeletal Sexual Character in Argentine Frog.*—J. Lesage describes the extraordinarily strong and ridged character of the humerus in the male of *Leptodactylus ocellatus*. This is an adaptation to the great muscular development of the forearm, one use of which is in embracing the female—the embrace lasting 15 to 20 days.

Age and Rate of Growth of Eel.†—K. J. Genzöe has found that the minute, deeply imbedded scales of the eel (*Anguilla vulgaris*), show annual rings (as in many other fishes), from which the age may be read. These scales appear first on the eels of 18 cm., and the fact that those below this fall into two groups of size points to the conclusion that two years pass before the scales appear. The males stay $4\frac{1}{2}$ to $8\frac{1}{2}$ (usually $5\frac{1}{2}$ or $6\frac{1}{2}$) years in fresh-water ; the females stay somewhat longer, for $6\frac{1}{2}$ to $8\frac{1}{2}$ (usually $7\frac{1}{2}$) years.

Brain of Lepidosiren.‡—G. Elliot Smith finds that the features of the brain in the Dipnoi, considered as a whole, are nearer to those of Amphibians than to those of any other Vertebrata. In the cerebral hemisphere there is a definite pallial formation, or cerebral cortex, distinctly separated from the ependyma as a clearly defined layer of nerve-cells. This pallial formation is homologous with the pallium of Amniota. An outstanding feature is the relatively enormous development and the high degree of specialisation of the tuberculum olfactorium. Three elements may contribute to the formation of the choroid plexus of the lateral ventricle in different Vertebrata : (1) The roof of the forebrain ; (2) a band formed from the attenuation of the pallio-thalamic junction ; and (3) the secondarily thinned caudal part of the paraterminal body.

Vascular Filaments on Pectoral Fin of Lepidosiren paradoxa.§—W. E. Agar found some breeding males with vascular filaments on the pectoral as well as on the pelvic fins. He asks whether it is a homœotic variation, or is it a reminiscence of the former exclusively respiratory function of the fin (on Graham Kerr's theory of the origin of the paired limbs from external gills). The period of the functional activity of the

* C.R. Soc. Biol. Paris, lxv. (1908) pp. 463-4.

† Rep. Dan. Biol. Stat. to Board of Agric., xiv. (1908) 30 pp. (1 fig.). See also Zool. Zentralbl., xv. (1908) p. 713.

‡ Anat. Anzeig., xxxiii. (1908) pp. 513-40 (18 figs.).

§ Tom. cit., pp. 27-30 (5 figs.).

pelvic filaments coincides with the period during which it would be of most use as an accessory respiratory organ—that is while the fish is guarding its eggs and young in the underground nest.

Habits of Miller's Thumbs.*—Theodor Gill gives an interesting account of *Cottus gobio* and related forms, calling attention to their habit of resting fixed to the bottom for a long time, the partial accommodation of their colour to the surroundings, their respiratory movements, which are about forty per minute, their omnivorous appetite and destructiveness to fish-eggs, the more intense colouring of the males, and so on.

Fishes of New South Wales.†—D. G. Stead gives a useful account of the edible fishes of New South Wales, written in the main from a practical point of view.

Fauna of the Obersee.‡—Guido Schneider has made a regional survey of this, the largest lake in Estland. He gives an account of its physical and chemical peculiarity, its flora and plankton, and fauna. There seem to be no Amœbæ, Heliozoa, Sponges, Bryozoa. There are few Rotifers or Annelids. Free Nematodes are abundant, e.g. two new species—*Chromadora lehberti* and *C. revaliensis*. Apart from the stickleback, the fishes are simply the common food-fishes, showing persistent isolation for centuries.

Fish living inside Strombus.§—L. Plate describes *Apogonichthys strombi* sp. n., from the Bahamas, which spends part of its time (the day ?) in the mantle cavity of large specimens of *Strombus gigas*. Like *Fierasfer* in Holothurians, it does not seem to do its host any good. Plate calls attention to *Amphiprion bicinctus* in the large sea-anemone *Crambactis arabica*, the small Carangidæ which are sheltered by large jellyfishes, and small fishes which live among the very long and hair-like spines of the dark-coloured rock-urchin (*Diadema saxatile*).

Tunicata.

Phagocytosis and Auto-digestion in Diplosoma.‖—A. Pizon continues his study of *Diplosoma*, which has three kinds of ascidiozooids—monothoracic, bithoracic, and bithoracic and biventric. Certain organs of the bithoracic type (which has two branchiæ, two gullets, and two rectal tubes) have an ephemeral existence. After 12–18 hours in the summer the older thorax (branchia, œsophagus, rectum) regresses and disappears in three or four days. The involution is characterised by the very active part played by the persisting digestive organs—there is a literal auto-digestion—and by the great phagocytic activity of amœboid cells.

Musculature of Salpa.¶—R. Streiff gives a detailed account of the musculature in the various species of *Salpa*, and shows how it may be

* Smithsonian Misc. Coll., v. (1908) pp. 101–16 (14 figs.).
† The Edible Fishes of New South Wales: their Present Importance and their Potentialities. Board of Fisheries, New South Wales (1908) 123 pp. (81 pls. and 1 map).
‡ Arch. Biontolog., ii. heft i. (1908) pp. 1–190 (10 pls.).
§ Zool. Anzeig., xxxiii. (1908) pp. 393–9 (2 figs.).
‖ Comptes Rendus, cxlvii. (1908) pp. 640–1.
¶ Zool. Jahrb., xxvii. (1908) pp. 1–82 (4 pls. and 11 figs.).

used for classificatory purposes. He divides the genus into three groups of species: Cyclosalpæ, Polymyariæ, and Oligomyariæ, the first being the most primitive, the last the most evolved.

INVERTEBRATA.

Mollusca.

α. Cephalopoda.

Embryos of Sepia.*—A. Distaso has studied the development of *Sepia*, paying particular attention to the vascular system, the secondary cavity of the body, the kidney, the gonad, and the nautiliform stage.

Branchial Hearts of Cephalopods.†—Cuénot, Gonet, and Bruntz find that the acid cells of the branchial hearts, which have a selective eliminative action on injected ammoniated carmine, normally inclose pigment, phosphates, ammoniacal salts, and xanthic bodies. It is probable that these waste products do not accumulate in the nephrocytes, but are passed into the blood, and got rid of at the kidneys.

β. Gastropoda.

Respiratory Epithelium in Pulmonate Gastropods.‡—D. Calugareanu and J. Dragoiu describe the minute structure of the mantle in the pulmonary chamber of snails and slugs. There is only a single cell-layer between the blood and the intra-pulmonary air. In *Limax* the wall is plaited, so that a sponge-like system of cavities is formed—an adaptation to increase the respiratory surface.

Statocysts of Heteropods.§—S. Tschachotin distinguishes in these bodies a connective-tissue capsule, a nerve-fibre layer, and an epithelial layer with its "macula" and "antimacula," both including ciliated and non-ciliated cells. The statolymph is a fluid, not a jelly. The statolith consists of calcite, along with some traces of magnesium and phosphorus compounds, and a stroma concentrically zoned.

Attempts to connect the statocysts with hearing gave no results. The organs seem to affect the tonus of the musculature, and to function as "static" organs. When they are destroyed there are disturbances of the orientation.

Sudanese Nudibranchs.‖—Sir Charles Eliot reports on a collection made by Cyril Crossland and J. G. Logan, which includes seven new species—*Pleuroleura glabra*, *Lomanotus vermiformis*, *Nembrotha limaciformis*, *Kentrodoris labialis*, *Peronodoris denticulata*, *Artachæa verrucosa*. The collection is interesting geographically, and the author refers to the possibility of some forms being carried on the bottoms of ships. The reappearance of *Okola pacifica*, *Thorunna furtiva*, and *Plocamopherus ocellatus*, is also interesting.

* Zool. Jahrb., xxvi. (1908) pp. 565–650 (6 pls. and 13 figs.).
† Arch. Zool. Expér., ix. (1908) Notes et Revue, No. 3, pp. xlix.–liii.
‡ C.R. Soc. Biol. Paris, lxv. (1908) pp. 521–3 (3 figs.).
§ Zeitschr. wiss. Zool., xc. (1908) pp. 343–422 (5 pls. and 15 figs.).
‖ Journ. Linn. Soc. (Zool.), xxxi. (1908) pp. 86–122.

Subradular Nervous System of Solenogastres.*—Harold Heath calls attention to the interest of the nervous system of *Chætoderma* and related forms. It is very conservative, retaining many ancestral features, indicating relationships otherwise most obscure. One of the enigmatical points is the so-called buccal or stomatogastric system, consisting of a connective arising from the brain on each side, and passing backward to a ganglion imbedded in the pharyngeal musculature. The ganglia in turn are united by a commissure passing beneath the gut in the neighbourhood of the radula or the outlets of the ventral salivary glands. Heath shows that in the genus *Chætoderma* what are usually termed the buccal ganglia and their connectives are in reality labio-buccal, giving rise, as in the Neomeniidæ, to subradular connectives and ganglia. The small ganglia inserted between the larger labio-buccal masses apparently originate no nerves, and are accordingly not to be definitely homologised.

Antarctic Solenogaster.†—H. F. Nierstrasz describes the single Solenogaster in the 'Discovery' collection, giving it the name *Proneomenia discoveryi*, and pointing out the distinctiveness of the species of this genus. He also takes a survey of the family Proneomeniidæ.

Bathysciadium, Lepetella, and Addisonia. —J. Thiele gives some account of these imperfectly known forms, which he refers to the Cocculinoidea, the first two genera being included in a family Lepetellidæ, while *Addisonia*, which is much further from the *Cocculina* type, requires a special family for itself.

δ. Lamellibranchiata.

Classification of Lamellibranchs.§—Mario Stenta discusses this problem. He first considers the relative values of the various organs for taxonomic purposes. He then states and criticises the arrangements proposed by Neumayr, Fischer, Pelseneer, Ménégaux, Dall, Jackson, Grobben, Bernard, Rice, Ridewood, Lankester, and others. The classification which seems to the author to be most real is that of Grobben: Protobranchiata (Nuculidæ, Solenomyidæ); Eutaxodonta (Arcidæ); Heterodonta (a large sub-order); and Anisomyaria (Aviculidæ, Mytilidæ, Pectinidæ, and Ostreidæ).

Arthropoda.

α. Insecta.

Regeneration of Wing in Lepidoptera.‖—J. Meisenheimer has succeeded in removing a wing-primordium from caterpillars of *Ocneria dispar*, and has found that the imago has the corresponding wing developed on a reduced scale. Werber and Kammerer have observed the replacement of a wing in the sexually mature imagines of *Tenebrio* and *Musca*, but there is nothing of this sort in Lepidoptera. The author

* Anat. Anzeig., xxxiii. (1908) pp. 365–7 (1 fig.)
† Nat. Antarctic Exped. (Zool.) iv. (1908) 13 pp. (2 pls.).
‡ Bull. Mus. Comp. Zool. Harvard, lii. (1908) pp. 81–9 (2 pls.).
§ Boll. Soc. Adr. Sci. Nat. Trieste, xxv. (1908) pp. 1–150.
‖ Zool. Anzeig., xxxiii. (1908) pp. 689–98 (1 pl. and 2 figs.).

points out that his results do not support the view that the regenerative capacity is always adaptive. The regenerating organ is internal and could hardly be injured without destroying the whole animal, though this was not the result in the author's hands. Removal of the gonads, or their exchange with those of another sex, does not affect the secondary sexual characters in the regenerated wing.

Polar Body Formation in Ant.*—W. Schleip has studied *Formica sanguinea*. There are about forty-eight chromosomes in the first segmentation-spindle; in the equatorial plate of the first directive spindle of the fertilised and of the parthenogenetic ovum there are about twenty-four; there is probably a pseudo-reduction (syndesis) in the prophase of the first directive division, the twenty-four chromosomes of the first directive spindle being interpreted as double-chromosomes. The polar bodies come to nothing in the parthenogenetic as in the fertilised egg. There is no "Richtungscopulationskern" as Petrunkewitsch believed.

In the development of a parthenogenetic ovum there are various possibilities as to the number of chromosomes. 1. There may be a reduction, and the normal number may be restored by the second polar nucleus uniting with the pronucleus (*Artemia salina*, observed by Brauer). 2. There may be reduction, and then the chromosomes may double (*Lasius niger* and *Rhodites rosæ*, observed by Henking). 3. There may be reduction, and a Richtungscopulationskern with the normal number is formed, from which the germ-cells are derived, while the chromosomes double spontaneously in the pronucleus (Drone-eggs, observed by Petrunkewitsch). 4. There may be no reduction and no doubling (probably in various saw-flies, Doncaster).

In *Formica sanguinea* the egg develops, at least to the stage of the germinal streak, with a reduced number of chromosomes.

Leg Tendons of Insects.†—C. W. Woodworth has studied the tendons, which are cuticular invaginations and subject to replacement at each moult. They belong to the same set of internal processes as the internal skeleton of the head and thorax, the tendons of the jaws, the great internal disk-like tendons for the attachment of the elevator muscles of the wings in Odonata, and the skeletal and tendinous process of the ovipositor.

Palæarctic Tortricidæ.‡—J. Kennel gives a monographic account of this family of moths, describing their general structure and life-history, sex-characters, variability, ethology, and systematic relationships. The phylogeny is discussed and summed up in a very striking diagrammatic plate.

Philippine Cassididæ.—J. Weise § describes some new Cassididæ, and W. Schultze ‖ discusses some life-histories. After a careful inquiry into the significance of the peculiar excremental coverings, filaments, or

* Zool. Jahrb., xxvi. (1908) pp. 651–82 (2 pls.).
† Amer. Nat., xlii. (1908) pp. 452–6 (2 figs.).
‡ Zoologica, xxi., heft 54 (1908) pp. 1–100 (6 pls., 1 genealogical tree, and text-figs.).
§ Philippine Journ. Sci., iii. (1908) pp. 259–60.
‖ Op. cit., pp. 261–71 (6 pls.).

armatures of the different stages of Cassididæ, Schultze comes to the conclusion that Candéze was right in regarding them principally as a protection against parasitic enemies such as Chalcidæ.

Lucilia as a Parasite.*—Erich Hesse notes several cases where newly dead toads were found to have larvæ of *Lucilia* developing in the head region, and several cases in which the infected toads were alive. He also saw *Lucilia* laying eggs in a living nestling of the mistle-thrush which had fallen from the nest.

Mosquito Breeding in Salt- and Fresh-Water.†—Charles S. Banks finds that *Myxomyia ludlowii* Theob. in the Philippines breeds in both salt- and fresh-water. The evidence is strong that this mosquito acts as a transmitter of æstivo-autumnal malaria. Altitude (up to 1500 metres), has no appreciable influence on its development. There is little hope of ridding a community like Cervantes of this insect, owing to the topographical features which are practically irremediable because of their extent.

Regeneration of Wing in Flies.‡—P. Kammerer has found that in *Musca domestica* and *Calliphora vomitoria* amputation of a wing has no result, but tearing of a wing from a newly pupated fly is sometimes followed by regeneration. The new wing is at first homogeneous and transparent, it subsequently gets veins, apparently after the normal pattern. An injury to one wing, or removal of one wing, may be followed by a proportionate reduction of the other wing.

Chironomid Larvæ living in Leaves.—Victor Willem § reports finding in the leaves of *Sparganium ramosum* the larvæ of *Chironomus sparganii* sp. n., and of another species, and in the leaves of *Stratiotes aloides* the larvæ of *Psectrocladius stratiotis* sp. n., and in the leaves of the water-lily the larvæ of *Chironomus nymphææ* sp. n. The first two species are described and named by J. J. Kieffer. ||

Phytoptid Galls of North America.¶—G. H. Chadwick has made a descriptive catalogue of 170 North American phytoptocecidia, distinguishing the following types: the erineum, or shallow dimple (formerly described as fungi), the dimple, the capsule, the pocket, and the pouch.

Abdominal Appendages of Male Dragonflies.**—O. S. Thompson discusses the appendages on or adjacent to the sternum of the second abdominal segment. They are used for copulation, and are quite different from those at the end of the abdomen that are used for capturing the female and leading her about. The sperm-ducts open on

* Biol. Centralbl., xxviii. (1908) pp. 753–8.
† Philippine Journ. Sci., iii. (1908) pp 335–9 (2 pls. and 3 maps).
‡ Arch. Entwickel ,xxv. (1907) pp. 349–60. See also Zool. Zentralbl., xv. (1908) pp. 631–2.
§ Acad. R. Belg. Bull. Classe des Sci., No 8 (1908) pp. 697–704 (1 pl.).
|| Tom. cit., pp. 705–7.
¶ Education Dept. Bull., State of New York, No. 433 (1908) pp. 118–55.
** Tom cit., pp. 249–63 (12 figs.).

the ventral side of the 9th abdominal segment; the copulatory apparatus is on the ventral side of the 2nd and 3rd segments; previous to copulation the abdomen is bent so that the vesicle at the front of the 3rd abdominal sternum is charged; the female is swung round so that her genital orifice is brought into contact with the accessory apparatus on the 2nd abdominal segment. A very careful account of the complex parts in their various stages of differentiation is given.

Arborescent Glands of Female Cockroach.* — L. Bordas describes these organs, first noted by Siebold and Dufour, which surround the rectum and the terminal portion of the hind-gut, and extend even to the oviducts and ovarioles. There are two of them, the left much larger than the right, and they have two apertures on the dorsal wall of the vaginal cavity. The left arborescent gland secretes crystals of carbonate of lime, very abundant at the time of oviposition, which serves to build up the ootheca or ovigerous shell.

Kidneys of Thysanura.† — L. Bruntz finds two kidneys in Thysanura, consisting of a labyrinth and a saccule, with excretory canals opening together at the base of the lower lip. The saccules eliminate ammoniacal carmine, and the labyrinths carminate of indigo.

Machilidæ and Lepismidæ have two pairs of cephalic glands, an anterior pair opening at the base of the masticatory cavity, and a posterior pair annexed to the excretory canals of the kidneys. Both pairs are mucous glands, the anterior pair may be called masticatory glands, the posterior pair may secrete a fluid which bears away the excretory products.

Antarctic Aptera.‡ — G. H. Carpenter describes a new Podurid from South Victoria Land, *Gomphiocephalus hodgsoni* g. et sp. n. It seems to be a Podurid with affinities to the Entomobryidæ, just as the Anurophorinæ—which include that remarkable antarctic genus *Crytopygus* (Willem, 1902)—are Entomobryids, with affinities to the Poduridæ. The presence of such ancient connecting links on the antarctic continent and islands might reasonably have been expected.

β. Myriopoda.

Dimorphic Spermatogenesis in Scutigera.§ — P. Ancel and P. Bouin note that two kinds of spermatozoa have been observed in *Paludina*, *Murex*, *Scolopendra*, *Pygæra*, etc., but they have observed in *Scutigera coleoptrata* two distinct spermatogenetic lineages, distinct from start to finish, resulting in giant spermatozoa rich in chromatin, and dwarf spermatozoa poor in chromatin.

δ. Arachnida.

Stridulating Organs in Mygalomorph Spiders.‖ — A. S. Hirst describes some new types of apparatus, which are situated on the inner

* C.R. Soc. Biol. Paris, lxv. (1908) pp. 533–5.
† Arch. Zool. Expér., ix. (1908) pp. 195–238 (3 pls).
‡ Nat. Antarctic Exped. (Zool.) iv. (1908) 5 pp. (1 pl.).
§ C.R. Soc. Biol. Paris, lxv (1908) pp. 287–9.
‖ Ann. Nat. Hist., ii. (1908) pp. 401–5 (5 figs.).

(anterior) surfaces of the mandibles, and are similar on the two sides. In *Selenogyra* the apparatus consists of a number of rows of bacillæ, arranged in a somewhat crescentic manner, the bacillæ of the outer rows being the largest. In *Euphrictus spinosus* g. et sp. n. (which the author describes) the organ is practically reduced to an oblique row of five strong spines.

Activities of Araneads.*—T. H. Montgomery has made a study of the age-differences in the snares of two Argiopids, with regard to the problem as to whether the snare becomes more complex as the spider grows older. The forms studied were *Epeira sclopetaria* and *E. marmorea*, both of which construct large, vertical, orbicular webs, which are easily measured. Webs made by immature and by adult spiders were compared in regard to (1) number of radii, (2) number of spiral loops, and (3) greatest diameter of the viscid spiral (orb proper). The age-changes in both species are greatest with regard to the diameter of the viscid spiral, less with regard to the number of its loops, and least with regard to the number of radii. The first snare of the spiderling has all the parts of that of the adult; but with increasing age the thread becomes thicker, the web larger, and there are a few more radii and loops. The differences are due to the increased weight of the spider and the increased size of the spinning-organs, and the consequent greater amount of silk. There is nothing either in the making of the snare or of the cocoon to indicate that the spider learns by experience.

Notes on the senses of touch and sight in snare-making spiders, and on the cocooning of *Loxosceles rufescens*, are appended.

Development of Spiders.†—P. Wallstabe describes the development of the form of the body in *Agelena labyrinthica*, paying particular attention to the appendages, the segmentation of the cœlom, the cavity of the head, and the like.

Hydrachnids from Tiree.‡—Wm. Williamson reports *Thyas longirostris* Piersig and *Tiphys liliaceus* Müller, which have not been recorded before for Scotland. He also got *Hydryphantes ruber* De Geer, which has been already recorded.

Malleoli of Solpugidæ.§—H. Rühlemann gives an account of the minute structure of the so-called malleoli or "coxal raquettes" on the fourth appendage of Solpugidæ. He describes the innervation, blood supply, tracheæ, and so on, and then goes into the details of the sensory cells and nerve fibres. The function of the organs—probably smell or taste—remains undetermined. Their resemblance to the pectines of scorpions is emphasized.

Podosomata of Temperate Atlantic and Arctic Oceans.‖—A. M. Norman revives Leach's title Podosomata for the Pycnogonids or

* Amer. Nat., xlii. (1908) pp. 697–709.
† Zool. Jahrb., xxvi. (1908) pp. 683–712 (2 pls. and 6 figs.).
‡ Ann. Scot. Nat. Hist. (1908) pp. 161–2.
§ Zeitschr. wiss. Zool., xci. (1908) pp. 599–639 (2 pls. and 8 figs.).
‖ Journ. Linn. Soc. (Zool.) xxx. (1908) pp. 198–238 (2 pls.).

Pantopoda, and gives an annotated list of those known from the Temperate Atlantic and Arctic Oceans. He describes *Nymphon stenocheir* sp. n.

ε. Crustacea.

Variation of Green Gland of Crayfish.*—E. Hindle describes a specimen of *Astacus fluviatilis* that had on each side an accessory opening behind the ordinary one. A duct was found in the posterior papilla, as well as in the normal position. The variation supports the view that the green glands constitute a pair of nephridia.

Abnormality in Copulatory Appendage of Crayfish.†—A. Briot describes an interesting anomaly in a male specimen of *Astacus fluviatilis*, which showed a jointed copulatory appendage on the right side. The outer side of the appendage shows six joints, the inner side only four. In other words, the jointing was not quite complete, but there was evidently an attempt at a thoracic limb.

Daily Life of Cambarus bartonius.‡—F. E. Chichester has made a study of the daily life and activities of the crayfish *Cambarus bartonius*. Two tanks were used, one containing running water with a sloping bank of sand, the other still water with a raised bank of mud covered with moss and kept damp. Constant observations were also made in the open, a strong acetylene light being used at night, and these showed that the behaviour of the crayfish in the tanks was normal. The observer finds that crayfish are most active at night, and that there is marked activity at nightfall and at daybreak. Feeding usually takes place at night, but may also occur through the day. In spring the crayfish eats much more often than in winter; there is apparently a consuming hunger after the spring moult. The species in question prefers fresh animal food to anything else. Feeding is followed by rest, prolonged periods of feeding being followed by equally prolonged periods of rest. There is apparently no spontaneous play or exercise, movements being purely utilitarian.

The female aerates her eggs both on land and in water. One female was observed to climb the mud bank, aerate her eggs for a few moments, and return to deep water, 84 times in 12 hours. The males do not distinguish between other males and females, but frequently grasp other males and attempt to copulate with them.

The crayfish frequently comes into the shallows and raises its carapace above water. Combing or cleaning movements are executed by means of the first and second ambulatory appendages, with which the crayfish scrapes the carapace.

Breeding-periods of Portuguese Crustaceans.§ — Luiz Gonzaga Do Nascimento discusses the periods of growth and reproduction in *Palinurus vulgaris*, *Homarus vulgaris*, *Cancer pagurus*, *Carcinus mœnas*, *Maja squinado*, and other well-known Crustaceans.

* Zool. Anzeig., xxxiii. (1908) pp. 584–5 (2 figs.).
† C.R. Soc. Biol. Paris, lxiv. (1908) pp. 1182–3.
‡ Amer. Nat., xlii. (1908) pp. 710–16.
§ Boll. R. Soc. Españ. Hist. Nat, 1908, pp. 1–8.

New Mediterranean Isopod.*—Emile G. Racovitza describes *Ischyromene lacazei* g. et sp. n., a new Isopod from Banyuls. It belongs to the family Sphæromidæ, and is nearly related to *Dynamenella* Hansen.

Cavernicolous Trichoniscinæ.†—E. G. Racovitza continues his elaborate account of cavernicolous Isopods. He divides the sub-family Trichoniscinæ into two sections: *Haplophthalmus*, the type of the one, and *Trichoniscus*, the type of the other. In the first section he includes: *Haplophthalmus* Schöbl., *Buddelundiella* Silvestri, *Cyphoniscellus* Verhoeff, with *Charesia* Dollfus incertæ sedis. In the second section he includes: *Trichoniscus* Brandt (with many sub-genera), and *Schiödtia* Budde-Lund, with *Oligoniscus* Dollfus incertæ sedis.

Regeneration and Moulting in Gammarus.‡—Mary T. Harman has tried to discover whether there is any relation between degree of injury and rate of regeneration. In one set of Gammarids the right-hind leg was removed; in another set the two pairs of hind legs were removed. She found that the degree of injury has no effect on the rate of regeneration or on the length of the moulting period.

Two New Northern Amphipods.§—T. R. R. Stebbing describes two blind forms collected by the 'Goldseeker' from considerable depths—*Lepechinella chrysotheras* g. et sp. n., ranked in the family Paramphithoidæ, although the integument is not indurated, and *Rachotropis palporum* sp. n. in the family Eusiridæ.

Anaspididæ.‖—G. W. Smith gives a short account of *Paranaspides lacustris* g. et sp. n. from the Great Lake of Tasmania, and discusses the position of the Anaspididæ. He has been able to study the habits of *Anaspides tasmaniæ* (Thomson) which creeps about at the bottom of the pools, keeping the body quite flat or unflexed, as in the related Carboniferous fossils. It seems to be omnivorous, but its chief food is algal slime. It will probably be exterminated by the introduced English trout. The exopodites of the thoracic limbs are entirely respiratory. The male and female openings are in the normal Malacostracan position, and the large median opening on the ventral surface of the last thoracic segment in the female is not, as Thomson supposed, the aperture of the oviducts, but opens into a blind pouch, the spermatheca, where the male deposits the spermatozoa.

The heart, which is tubular and elongated, stretches through the whole of the thorax, and passes without a very definite constriction into the abdomen. There is apparently a single pair of ostia in the third thoracic segment. The whole structure of the alimentary canal is peculiar, and not quite like that of any other group of the Crustacea; it has a simple gastric mill, about thirty glandular cæca, and two unpaired dorsal cæca in the abdominal region.

The nerve-cord consists of eight free thoracic ganglia and six

* Arch. Zool. Expér., ix. (1908) Notes et Revue, No. 3, pp. lx.–lxiv. (2 figs.).
† Tom cit. pp. 239–415 (20 pls.).
‡ Proc. Indiana Acad. Sci., 1907 pp. 62–75.
§ Journ. Linn. Soc. (Zool.) xxx (1908) pp. 191–7 (2 pls.).
‖ Proc. Roy. Soc., Series B, lxxx. (1908) No. B 543, pp. 465–73 (1 pl. and 6 figs.)

abdominal ganglia. No antennary glands are present, but there are maxillary glands — a primitive character. The ovaries and testes are paired tubes stretching the whole length of the body; their ducts are simple tubes not provided with accessory glands. The adult spermatozoa are filiform, with globular heads and an elongated flagellum.

The pale purple ova, about 1 mm. in diameter, are probably fertilised as they pass out by spermatozoa which migrate from the spermatheca. The female deposits and hides her eggs singly, and not agglutinated together, under stones and among the roots of water-plants, being the only crustacean (with the possible exception of the peculiar parasitic Argulidæ) that does this.

The new type *Paranaspides* lives among the rocks and water-weeds in the littoral zone of the lake; it has a marked dorsal flexure and a swimming habit. The mandible bears a four-jointed and distinctly biramose palp, a characteristic only found elsewhere among Copepods; the first thoracic appendage bears on the inner face of the antepenultimate joint a setose lobe used in mastication.

The author agrees with Calman that the Schizopods should be done away with as a natural group, and that the Anaspididæ (*Anaspides* and *Paranaspides*) and Koonungidæ (*Koonunga*) should be placed in a separate division, Anaspidacea, apart from Peracarida and Eucarida.

Antarctic Schizopods.* — W. M. Tattersall reports on thirteen species collected by the 'Discovery,' ten from strictly antarctic waters, more than doubling the list of south polar Schizopods. There are no species common to the fauna of both polar regions, but all the genera, save one, *Antarctomysis*, are represented in northern waters, by species which are quite distinct from their southern allies. It is probable that what are now known to be bipolar genera and species, will be found to be cosmopolitan, as has been shown in regard to *Lophogaster typicus*, a stock instance of a bipolar form.

Species of Oithona.†—G. P. Farran describes from the west and south-west of Ireland two new species of *Oithona*—*O. atlantica* and *O. pelagica*—which he distinguishes from *O. plumifera* and *O. setigera*. The distinction between *O. setigera* and *O. pelagica* lies only in the presence of clavate or tapered setæ on the basals of the swimming feet. Possibly this distinction may be regarded by some as insignificant; but until it is shown that the two varieties of setæ can occur in specimens from all localities, it ought not to be disregarded.

Loricula darwini.‡ — Henry Woodward describes this fine new species of Cirripede from the Middle Chalk (Turonian), near Rochester, Kent, which differs from *L. pulchella* in its much greater size and more remarkable capitulum, and in certain distinctive features in the form of the scutum and the latera.

Antarctic Copepods.§—R. Norris Wolfenden describes a new genus, *Paralabidocera*, and seven new species. He finds that the Antarctic

* Nat. Antarctic Exped. (Zool.) iv. (1908) 42 pp. (8 pls.).
† Ann. Nat. Hist., ii. (1908) pp. 498-503.
‡ Geol. Mag., v. (1908) pp. 491–9 (2 figs.).
§ Nat. Antarctic Exped. (Zool.) iv. (1908) 44 pp. (7 pls.).

Copepod fauna is distinct from that of the Arctic seas, and that the species which are typical of this region, and most numerous, do not extend far into the southern Atlantic.

New Parasitic Copepod.* — V. Dogiel describes *Entobius loimiæ* g. et sp. n., an endoparasitic Copepod in the intestine of a Terebellid (*Loimia medusa* ?). The female, 3·5–4 mm. in length, shows a head-region (with reduced appendages, two pairs of antennæ, mandibles, a pair of maxillæ, and a pair of maxillipedes) ; a thoracic region of four segments bearing biramose appendages of great simplicity ; and a posterior region without appendages. The male is quite like the female, but smaller. The first larval stage is a metanauplius. As to the systematic position of this interesting form, it may be referred to the vicinity of *Mytilicola intestinalis*.

Nerves of Entomostraca.†—Alfred Fischel has been able to discover, by intra-vitam staining with alizarin, some new details regarding the nervous system in *Daphnia longispina* (e.g. a network on the posterior and ventral wall of the brood-capsule) and *Bosmina longicornis* (e.g. a ganglion at the root of the caudal setæ).

Optic Organs of Eucalanus.‡ — C. O. Esterley has studied the light-recipient organs of the Copepod, *Eucalanus elongatus*. The median eye is of the tripartite type ; each lateral ocellus consists of two basal plates and of nine retinal cells ; the ventral ocellus contains ten cells, and is provided with a single basal plate similar to those of the lateral portions of the eye. The basal plates are products of the retinal cells, and probably do not contain the pigment of the eye, which is believed to be in a central cell, upon or in which the three divisions of the eye rest. The tapetum lies upon the peripheral margins of the central cell.

The retinal cells are provided, in their cytoplasm, with "interior bodies" or phaosomes, generally of a flattened rod-like form, arranged in such a way that when sectioned the long axis of their section corresponds with the long axis of the section of the cell. The axis cylinders of the optic nerves leave the retinal cells at the basal or deep ends (those adjoining the pigment-cell), and pass through, or to one side of the basal plates to enter the central cell. The individual fibres traverse the central cell toward the brain. There are twenty-eight fibres in the optic nerves, the same number as the sum of retinal cells. Probably one fibre comes from each cell.

The terminations of the nerves in the sensory cells are not in the form of a "Stiftchensaum." The neurofibrils are rather irregular, somewhat beaded and branched ; each ends in a club-shaped enlargement. Consequently the character of the nerve-ending cannot be regarded as similar to that in the visual cells of worms, as Hesse has maintained.

The cells of the median eye are not of the inverted type commonly found among flat worms and Polychæts. Therefore the median eye is not to be regarded on this character as a structure inherited from worm-

* Zool. Anzeig., xxxiii. (1908) pp. 561–7 (5 figs.).
† Tom. cit., pp. 698–701.
‡ Bull. Mus. Comp. Zool. Harvard, liii. (1908) pp. 1–55 (6 pls.).

like ancestors. The "interior bodies" and neurofibrils seem to be structurally continuous. Their functional inter-relationship is therefore probable. The ventral division of the median eye is simply a thickening of the hypodermis of the body, and has retained, in the adult, its original position. The lateral divisions of the eye lose all except a very slight connection with the hypodermis. The ventral division is in position epithelial; the lateral divisions are, in effect, sub-epithelial. These relations suggest that the lateral ocelli of *Eucalanus* are homologous with the lens eyes of the Pontellidæ. The ventral ocellus in *Eucalanus* corresponds with the ventral eye of *Pontella*.

The organ of Claus is regarded as a bicellular, inverted eye. These organs are located symmetrically in the brain. Each cell of an organ of Claus has a basal plate and interior bodies, as in the median eye. The nerves from the organs of Claus do not pass through the basal plates, but leave the periphery of the cell at a point which is opposite to the basal plate. In comparison with the retinal cells, these are consequently inverted. In position the organs of Claus are sub-epithelial, and since they lie in the brain as well, they are strictly comparable to the inverted pigmented ocelli of certain worms. Through the organs of Claus, and not through the "median eye," relationship with worms may be sought. Heretofore the median eye has generally been regarded as inverted, and on this character likened to the eyes of flat worms, which present that condition. Esterly has shown that the median eye of *Eucalanus* gives no support to that view.

Annulata.

Luminescence of Acholoe astericola.*—F. Falger has investigated this luminous Polynoid that lives on starfishes. The luminous area is in the elytra, on a crescent-shaped marginal dark border which blackens with osmic acid. The elytra may shine for 16 hours after their removal from the worm. An essential condition of the luminescence is free oxygen; an oxidation certainly occurs; and some stimulus (mechanical, chemical, thermal, or electrical) is always necessary.

Tubes of Chætopterus.†—Howard E. Enders has made some interesting observations on the formation and enlargement of the tubes of *Chætopterus variopedatus*. The tubes are formed from mucus which hardens into a parchment-like material, moulded by the ventral lip of the buccal funnel. They are at first tunnels, but afterwards have the form of a U. They can be enlarged both in length and diameter.

Larva of Lanice conchilega.‡—G. A. Elrington gives some account of the larva of this Polychæt, which Giard regarded as an adult and named *Wartelia gonotheca*. The so-called brain-cells which Claparède observed, which were regarded as ova by Giard and Nordenskiold, are in reality glandular cells. They form a dorsal gland, the secretion of which is used in forming the transparent tube which the larva inhabits.

* Biol. Centralbl., xxviii. (1908) pp. 641–9.
† Proc. Indiana Acad. Sci., 1907 (1908) pp. 128–33 (2 pls.).
‡ La Cellule, xxv. (1908) pp. 103–12 (1 pl.)

The dorsal gland is temporary, and disappears when the larva abandons its pelagic habits and begins to construct its sandy tube. The larvæ were found to possess three separate pairs of nephridial ducts without nephrostomes, but the relation of these larval nephridia to those of the adult was not determined.

Protandry in Grubea.*—G. Du Plessis has studied *Grubea protandrica* sp. n., one of the Syllids, which is neuter in summer, male in autumn and winter, and female in spring. In April, after the testes have disappeared, there is a short period during which there are ripe spermatozoa in the testicular segments, while ova are being formed in all the posterior segments.

Polyspermy in Protula meilhaci.†—A. Soulier finds that polyspermy is not infrequent in this Annelid; several spermatozoa unite with the female pronucleus, acting as kinetic centres and giving rise to multipolar figures. The chromatin of the ovum is distributed in fragments in the cytoplasm. Eggs that exhibit this degenerate. In artificial fertilisation all the eggs may fall victims to polyspermy. Lack of oxygen seems to favour it.

Giant Nerve-cells of Halla.‡—J. H. Ashworth describes the giant cells which occur in segmental couples in each of the anterior ganglia of *Halla parthenopeia*. Each giant fibre, after leaving the giant cell from which it arises, crosses the cord to the opposite side, turns gradually towards the middle line of the cord, and runs posteriorly. The neurofibrillar network in the giant cell is divisible into a perinuclear, situated at the margin of the perinuclear zone, and a more extensive, wider meshed, and generally more slender-stranded network in the general protoplasm. In *Aglaurides fulgida* similar giant cells and fibres are found.

Regeneration in Saccocirrus.§—Aug. Michel describes the growth of an anterior bud from the injured head-end of the primitive Annelid. *Saccocirrus papillocercus*. The bud showed eyes and antennæ, and hints of six segments. After two weeks there was a regulative reduction of antennæ and segments, and a ganglionic rudiment appeared.

Regeneration in Spirographis spallanzani.‖—P. Ivanov found that pieces of the abdominal region, or of the abdominal and thoracic regions together, regenerated the missing ends. At the posterior end a pygidium grows which gives rise to a large number of new abdominal segments. At the anterior end a primordium is formed which differentiates into four segments: the mouth-segment, the collar-segment, and the two first setiferous segments (making the prothoracic region in all). By a partial change in the six most anterior of the old segments, the posterior thoracic region is formed.

The results go to show that the prothoracic segments of the sedentary

* Rev. Suisse Zool., xvi. (1908) pp. 321–8 (1 pl.).
† Arch. Zool. Expér., ix. (1908) Notes et Revue, No. 3, pp. liii.-lv.
‡ Proc. Roy. Soc., Series B, lxx. (1908) No. B 543, pp. 463–4.
§ Comptes Rendus, cxlvii. (1908) pp. 1005–6.
‖ Zeitschr. wiss. Zool., xci. (1908) pp. 511–58 (3 pls. and 2 figs.).

Polychæts correspond to the head-segments of other Polychæts. The post-thoracic segments represent differentiated abdominal segments or ordinary trunk segments.

Antarctic Species of Phascolosoma.*—W. F. Lanchester describes *P. socium* sp. n., a Sipunculid presenting in the main the chief features of the *P. margaritaceum* group.

New Deep-sea Echiurid.†—Iwaji Ikeda describes *Protobonellia mitsukurii* g. et sp. n., from Sagami Bay. The proboscis is long and tubular, not bifid. The body has two distinct ventral hooks, without anal spine. There is a single genital duct with a long-stalked and fimbriated funnel. The anal glands are once branched before ending in ciliated funnels. The eggs have a nutritive cell-mass, appearing, as in *Bonellia*, like a cone at one pole. The alimentary canal and blood-vessels are well developed. The new genus is nearly related to *Bonellia*, but more primitive.

Penis of Criodrilini.‡—Luigi Cognetti de Martiis gives a detailed account of the so-called "penis" in *Alma* and *Criodrilus*, devoting particular attention to the vascular supply and the glandular differentiation. He does not think that the penis has anything special to do with respiration (as has been suggested), but that is specialised in connection with copulation, and, perhaps, with the formation of the envelope of the spermatophores.

New Leech.§—Ernest E. Hemingway describes *Placobdella pediculata* sp. n. from the isthmus or shoulder of the sheepshead (*Aplodinotus grunniens*) in Lake Pepin, Minnesota. As the attachment continues, the inflamed tissues of the host grow up like a collar, and close in around the body of the leech in front of the collar. The most striking external peculiarity is the attenuation of the posterior somites to form a narrow pedicel just in front of the posterior sucker, which consequently stands out freely in a most characteristic manner.

New Myzostomum.‖—Rudolf Ritter von Stummer-Traunfels describes a new species of *Myzostomum* (*M. antarcticum*) on *Antedon adriani*, a new Crinoid found by the 'Discovery' in the Antarctic. He also reports from the same host another species, *M. cysticolum*, which has been previously obtained in Ross's Sea in the Antarctic, off the east coast of Japan, and in the Tropical West Atlantic—a fine instance of wide distribution, which finds explanation in the antiquity of the group and in the uniformity of deep-water conditions. The southern range of the Myzostomidæ has been extended by these discoveries.

Nematohelminthes.

Notes on Nematodes.¶—Fayet and Moreau give an account of *Filaria irritans* (discovered in 1868 by Rivolta), which occurs in the

* Nat. Antarctic Exped. (Zool.) iv. (1908) 6 pp.
† Annot. Zool. Japon, vi. (1908) pp. 259–65 (4 figs.).
‡ Atti R. Accad. Sci. Torino, xliii. (1908) pp. 1122–37 (1 pl. and 1 fig.).
§ Amer. Nat., xlii. (1908) pp. 527–32 (3 figs.).
‖ Nat. Antarctic Exped. (Zool.), iv. (1908) 26 pp. (1 pl.).
¶ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 10–11.

summer sores of horses. It is a minute (2·5–3·5 mm.) Nematode, of a silvery white colour, very refractive, and finely striated both longitudinally and transversely.

Nervous System of Ascaris.*—R. Goldschmidt has studied this in detail in *Ascaris lumbricoides* and *A. megalocephala*. The ganglia include various types of cells—central cells, commissural cells, sensory cells. The following ganglia are distinguishable: cephalic ventral, cephalic dorsal, cephalic subdorsals, cephalic internal laterals, cephalic internal posterior laterals, cephalic external anterior laterals, cephalic external median laterals, cephalic external posterior laterals, commissurals, those of the subdorsal and subventral papillary nerves, and of the lateral papillary nerves. The author goes on to the nerves and their chief commissure the complex nerve ring. His analysis is so detailed that he can literally follow out every nerve fibre in the anterior end of the Ascarid.

Cystidicola farionis.†—A. E. Shipley has some notes on this threadworm which lives in the swim-bladder of the trout, and R. T. Leiper‡ describes its structure. The eggs have thick shells with a curious tuft of exceedingly delicate filaments, two or three in number, attached to a small cuticular knob at each pole.

Platyhelminthes.

Crystalloids in Epithelial Cells of Planarians.§—H. Sabussow describes peculiar crystalloids in the external epithelium of the penis in *Sorocelis pardalina* Grube and in *Planaria armata* Sab. In the former they are 4- or 6-sided plates and prismatic forms; in the latter they are tetrahedral. They are probably albuminoid. Perhaps they serve the same purpose as the chitinous terminal pieces in some Turbellarians.

History of Nuclei of Yolk-cells in Rhabdocœlids.‖—Paul Hallez studied this in *Paravortex*. He finds that after the formation of the cocoon the lecithogenous cells, which number about a hundred, become fluid, and the ectolecithin consists of a protoplasmic mass with the nuclei and ergastoplasmic granules of the lecithogenous cells. The ergastoplasm disappears gradually as the embryos develop and some of the nuclei degenerate. Most of them, however, re-awaken after a period of inactivity and multiply by direct division. The nuclei along with part of the ectolecithin form the greater part of the epidermis and the intestinal syncytium.

Cestode Cysts in Flesh of Butterfish.¶—Edwin Linton has made a study of the cysts of *Otobothrium crenacolle*, frequent in the flesh of the butterfish (*Poronotus triacanthus*). He found the adult some years

* Zeitschr. wiss. Zool., xc. (1908) pp. 73–136 (3 pls. and 22 figs.).
† Parasitology, i. No. 2 (1908) pp. 190–2. ‡ Tom. cit., pp. 193–4.
§ Zool. Anzeig., xxxiii. (1908) pp. 537–47 (6 figs.).
‖ Comptes Rendus, cxlvii. (1908) pp. 390–1.
¶ Bull. Bureau of Fisheries, Washington, xxvi. (1907) pp. 111–32 (2 pls.).

ago in the spiral valve of the hammerhead shark (*Sphyrna zygæna*) which eats the Teleosts. Practical considerations are discussed at some length.

Egg-making in a Trematode.*—Edwin Linton gives a vivid description of the process of egg-making in *Epibdella bumpusii*, an ectoparasite of the sting-ray (*Dasyatis centrura*). A mass of yolk leaves the yolk-reservoir ; as it passes the germ-duct a germ is drawn out by the suction ; yolk-mass and germ together pass along the common duct to the ootype ; an egg is moulded into a tetrahedral shape by a kind of hammering action of the walls of the ootype, and a shell is formed from substance secreted by the shell-forming gland ; a slowing-up of the action of the ootype is followed by the appearance of a minute cluster of sperms in the common duct ; this cluster of sperms comes from the seminal duct, and passes along the common duct to the ootype ; a momentary pause marks the arrival of the sperm at the ootype ; powerful contractions of the walls of the ootype eject the egg from the uterus into the water.

Incertæ Sedis.

Nutritive Process in Tornaria.†—A. T. Masterman finds that ingestion is effected by ciliary currents, the extra-stomial ingestion being due to the circum-oral band and the ciliated walls of the vestibule, the intra-stomial ingestion being effected by the cilia lining the pharynx. The water of the ciliary currents is probably returned along the lateral grooves of the pharynx, and then by the corners of the mouth to the exterior. Digestion is intra-cellular in the stomach (digestive area), but may also be inter-cellular—in the stomach, and in the intestine also. Currents in the stomach and intestine are ciliary. The pylorus and anus are worked by the rhythmic contractility of the surrounding walls.

Swimming Habit of Japanese Enteropneust.‡—Iwaji Ikeda observed in the Inland Sea, 50 miles east of Hiroshima, a sheet of swarming Enteropneusts (*Glandiceps hacksii* Marion), about a hundred in a cubic foot, on an average about 8 cm. in length. The swarming on the surface is said by the fishermen to occur on calm nights from August to the beginning of September, but not every year. The post-hepatic region is flattened, and the gut contained micro-organisms without sand. This species is probably a swimmer and a creeper, but not a burrower. Perhaps it comes to the surface after micro-plankton, for the swarming does not seem to have to do with sexual maturity.

New Genus of Fresh-water Bryozoa from Japan.§—Asajiro Oka describes *Stephanella hina* g. et sp. n, which seems to be referable to the Plumatellidæ. There is a thin, branched, creeping stolon ; the zoœcia are cylindrical and upright ; the ectocyst is gelatinous and transparent ; there is an epistome ; the lophophore has very short arms ; there are

* Biol. Bull., xiv. (1908) pp. 19–26 (5 figs.).
† Quart. Journ. Micr. Sci., lii. (1908) pp. 481–93 (1 pl.).
‡ Annot. Zool. Japon., vi. (1908) pp. 255–7.
§ Tom. cit., pp. 277–85 (1 pl.).

36–40 tentacles, the crown is almost funnel-shaped, with an inturning at the anal side ; the statoblasts are flat, circular, with an annular float, and no marginal spines.

Rotifera.

Philodina macrostyla and its Allies.*—James Murray gives a summary of all that is known of this interesting but difficult group, notable for the extreme variability of some of the species. Seven forms and their varieties are figured.

Notommata (Copeus) pseudocerberus sp. n.†—P. de Beauchamp, having previously described as *N. cerberus*, a species which he now finds to be really new, gives a detailed account of the differences between these two closely allied forms.

Gelatinous Envelope in Plankton Rotifers.‡—R. Lauterborn calls attention to the fact that *Rattulus cylindricus* Imhof (*Mastigocerca setifera* Lauterborn), is surrounded by a large gelatinous envelope, which is so transparent as to be invisible until brought out by mixing Indian ink with the water. Of other free-swimming Rotifers the author has found only *Hudsonella pygmæa* to have a similar, but very thin gelatinous envelope, which swells up very greatly when the animal dies or is killed and stained. We may add that *Notops hyptopus* has a like envelope.

Desiccation of Rotifers.§—D. D. Whitney finds that out of forty-five different species belonging to seventeen families of free-swimming Rotifers, only two, *Philodina roseola* and *P. citrina* could successfully withstand desiccation and resume normal activities when again placed in water. The author concludes that it seems probable that desiccation of the adult Rotifers, followed by revival, is not of widespread occurrence in the group, and is not the means resorted to by most species for tiding over unfavourable periods. Survival is due in most cases to the winter eggs, which can withstand both desiccation and low temperature.

Formation of New Colonies of Megalotrocha alboflavicans.‖—Frank M. Surface gives a very interesting account of the formation of new colonies of this Rotifer, showing quite complex instincts and reactions to stimuli. The main features are as follows. When first hatched from the eggs the young have a ciliated foot and two eyes and are free-swimming, but do not leave the colony singly. These individuals come together into a swimming ball, which reacts positively to light. Later, under certain conditions, particularly absence of light stimulus, the ball breaks up into free individuals again. These then aggregate themselves into a permanent fixed colony in which the animals spend the remainder of their lives, having lost the two eyes and the circlet of cilia at the foot. In this colony formation the mucus-like secretion of the foot-gland plays an essential part.

* Journ. Quekett Micr. Club., ser. 2, x. (1908) pp. 207–26 (3 pls.).
† Zool. Anzeig., xxxiii. (1908) pp. 399–403.
‡ Tom. cit., pp. 580–4.
§ Amer. Nat., xlii. (1908) pp. 665–71.
‖ Biol. Bull. Univ. Pennsylvania, xi. (1906) pp. 182–92.

Monograph of the Melicertidæ.* — Stanislav Hlava, whilst describing and figuring more fully the various species of this family that have been found in Bohemia, gives an account of all the known species. No new species are described, but some ancient names have been revived which appear to have the merit of priority according to modern rules.

Rotifera of the Exeter District.†—John Stevens gives a list of 171 species of Rotifera observed by him in the neighbourhood of Exeter, including some rare species such as *Dinops longipes*, *Microcodon clavus*, and *Copeus spicatus*. The author also records observations, showing that *Proales decipiens* enters the tubes of *Stephanoceros eichhorni*, devours the occupant, including the eggs, and then lays its own eggs in the empty case, all of which occupies about sixty hours, and then departs, leaving its brood to take care of itself.

Echinoderma.

Antarctic Echinoderms.‡—F. Jeffrey Bell reports on the 'Discovery' collection, and describes a number of new species—*Pseudopsolus ferrari*, *Antedon adriani*, *Asterias longstaffi*, *Heuresaster hodgsoni* g. n., *Pentagonaster incertus*, *Ophiura koehleri*. He calls attention to the wide range of variation in *Ophiozona inermis* and in *Cycethra verrucosa*. The 'Discovery,' like the 'Gauss,' was fortunate in re-discovering the interesting Crinoid *Promachocrinus*, which was one of the prizes of the voyage of the 'Challenger.'

Echinoderm Larvæ from the Antarctic.§ — E. W. MacBride and J. C. Simpson report on two Plutei (of a sea-urchin and an Ophiuroid) —which are probably the first free-swimming Echinoderm larvæ found within the Antarctic circle, on the brood-pouch and embryos of *Cucumaria crocea*, and on the early stages of *Asterias brandti*.

Effect of Alkaloids on Early Development of Sea-urchin.‖ — S. Morgulis finds that alkaloids, such as atropine, pilocarpine, morphine, digitaline, strychnine, or quinine, when present in very small quantities in the sea-water, have no influence on the developing eggs of *Toxopneustes variegatus*, but begin to act when they approach a certain concentration. Pilocarpine does not hasten the development, and larvæ developing in pilocarpine solutions are either of the normal size or a little smaller. Pilocarpine and atropine mixed in various proportions do not neutralise each other's action, but the depressing effect predominates.

Species of Holothuria Studied Biometrically.¶ — C. L. Edwards expounds the use of biometrical methods in taxonomy, and gives the following illustration. A common Florida-Caribbean Holothurian was described in 1851 by Pourtalès as *Holothuria floridana*. In 1868

* Arch. Natur. Land. Böhmen, xiii. (1908) pp. 1–83.
† Proc. College Field Club, Exeter, 1907, pp. 30–52.
‡ Nat. Antarctic Exped. (Zool.) iv. (1908) 16 pp. (5 pls.).
§ Tom. cit., 9 pp. (1 pl.).
‖ Proc. Amer. Acad. Arts and Sci., xliv. (1908) pp. 133–46.
¶ Amer. Nat., xlii. (1908) pp. 537–40.

Semper considered this identical with *H. atra* Jäger (1833) from the Celebes. All authors followed Semper till 1905. In the meantime, Ludwig, in 1883, recognised a species in the West Indies different from the Indo-Pacific form, and failing to identify it with *H. floridana* Pourtalès, created a new species, *H. mexicana*. The same error was repeated by Theél, in 1886, in making his *H. africana*.

Edwards obtained 138 specimens, and submitted every important character to statistical study. The result is that *H. floridana* Pourtalès is re-established as a valid species, with *H. mexicana* Ludwig and *H. africana* Theél as synonyms.

Sudanese Crinoids.*—H. C. Chadwick reports on six species of *Antedon* collected by Cyril Crossland in the Sudanese Red Sea. None is new, but only two of them have been previously recorded from the Red Sea.

Ecology of Recent Crinoids.†—A. H. Clark takes a survey of the recorded data in regard to recent Crinoids, with a view to suggesting lines of work which may throw light on the problem of the inter-relation of the Crinoids and the other classes of marine Invertebrates, and on the relation of the Crinoids to marine conditions in general. An analysis of the conditions of the localities in which the large forms occur, shows that the only factor common to them all is a very abundant food supply. In regard to colour the data seem to show that the smaller stalked forms are invariably and unchangeably yellow, and this colour may be, as in the case of parrots among birds, equivalent to a lack of colour. Black is added to the basic colour of Comatulids at all depths, and appears to denote age. Blue is added apparently only within 200 fathoms of the surface. The mosaic forms are all littoral, or shallow-water types. The same species may show different colours according to the bottom on which it occurs, and according to the depth of the water. There is, apparently, a close connection between colour and amount of illumination, the blue increasing with the light. Crinoids are too calcareous to be desirable as food, and it is possible that their brilliant colouring is of advantage in attracting small organisms.

Cœlentera.

Antarctic Sea-Anemones.‡—Joseph A. Clubb reports on eight species collected by the 'Discovery.' Two are new—*Paractis polaris* and *Cystiactis antarctica*. In *Cribrina octoradiata* (Carlgren) there are sixteen brood-pouches, which arise as invaginations of the three layers of the body-wall. Each has an external pore, and usually contains two embryos.

Stinging by Jellyfish.§—E. H. H. Old reports on several cases in the Philippines of unusual symptoms caused by contact with some unknown kind of jellyfish. The unknown irritant or poison brings

* Journ. Linn. Soc. (Zool.) xxxi. (1908) pp. 44–7.
† Amer. Nat., xlii. (1908) pp. 710–26.
‡ Nat. Antarctic Exped. (Zool.) iv. (1908) 12 pp. (3 pls.).
§ Philippine Journ. Sci., iii. (1908) pp. 329–33.

about hysterical conditions, with incessant cough, restlessness, pain, nausea, etc. Alkaline solution was used locally, and morphine sulphate hypodermically.

New Chrysogorgids.*—W. Kükenthal describes five new species and a new variety of *Chrysogorgia*, collected by the German Deep Sea Expedition and by Dr. Doflein. The genus has an abyssal distribution in the warmer parts of the Pacific, Indian, and Atlantic Oceans.

Sudanese Alcyonarians.† — J. Arthur Thomson and James M. McQueen report on a collection of Alcyonarians made by Cyril Crossland in the Sudanese Red Sea. There are twenty-six species, of which the following are new: *Lithophytum crosslandi*, *L. macrospiculatum*, *Spongodes suesiana*, *S. pharonis*, and *Melitodes splendens*. The most interesting species, however, are *Clathraria rubrinodis* Gray, and *C. acuta*, striking forms which do not seem to have been noticed since Gray described them in general terms many years ago. A provisional list is given of the known Red Sea Alcyonarians.

Revision of the Family Melitodidæ.‡ — W. Kükenthal arranges the genera of this Alcyonarian family in the following scheme:—

I. Polyps with projecting calyces.
  A. Branching from the nodes, terminal twigs sometimes from the internodes.
    i. Cortical spicules—spindles or spinose clubs.
      a. Nodes and internodes penetrated by endodermal longitudinal canals. Polyps predominantly on one surface of the branches.
        1. Genus *Melitodes* Verrill.
      b. No endodermal canals in the internodes. Polyps distant and biserial.
        2. Genus *Acabaria* Gray.
    ii. Cortical spicules—also foliate clubs.
        3. Genus *Mopsella* Gray.
    iii. The foliate clubs modified into rounded bodies.
        4. Genus *Wrightella* Gray.
  B. Branching from the internodes.
        5. Genus *Parisis* Verrill.
II. Polyps without projecting calyces.
        6. Genus *Clathraria* Gray.

Kükenthal describes new species of *Melitodes* (4), *Acabaria* (7), *Mopsella* (3), *Wrightella* (1), and *Clathraria* (2). His diagnosis of *Clathraria* does not seem to us to apply very satisfactorily to the two species on which Gray established the genus.

Variation in Plumularia.§—S. Motz-Kossowska finds that *Plumularia lichtensterni* Mark. Turn. may give rise to forms which have been referred to the genera *Antenella* and *Polyplumaria*, and to species like

* Zool. Anzeig., xxxiii. (1908) pp. 704–8.
† Journ. Linn. Soc. (Zool.) xxxi. (1908) pp. 48–75 (4 pls. and 4 figs.).
‡ Zool. Anzeig., xxxiii. (1908) pp. 189–201.
§ Arch. Zool. Expér., ix. (1908) Notes et Revue, No. 3, pp. lv.–lix. (3 figs.).

P. secundaria. It gives rise to varieties which seem to be due to spontaneous variations, but which in certain conditions may become fixed and form "good species."

Sudanese Hydroids.*—Laura Roscoe Thornely reports on a collection of eighteen species made by Cyril Crossland, including the following new forms: *Perigonimus vagans*, *Lovenella corrugata*, and *Ceratella crosslandi* (?). The last is an interesting form, 9 in. high by 12 in. wide, much branched, here and there anastomosing, with the hydrophore reduced to two wing-like pointed processes, one on either side of the aperture.

Distribution of Diphyes arctica.†—Hjalmar Broch has some notes on the North Sea Siphonophora — *Muggiæa atlantica* Cunningham, *Galeolaria biloba* M. Sars, *Diphyes truncata* M. Sars, and *D. arctica* Chun. The last mentioned is an arctic species which occurs in the deep parts of the North Sea, sporadically off the west coast of Norway, frequently in the deep waters of the Skagerrak.

Transverse Division in Hydra.‡—W. Koelitz has observed on many occasions the transverse division of normal and healthy specimens of *Hydra viridis*, *H. fusca*, and *H. grisea*, and regards it as an ordinary mode of multiplication. In a few days the two halves grow into intact polyps.

Porifera.

Antarctic Calcarea.§—C. F. Jenkin reports on the 'Discovery' collection of Calcareous Sponges, which contains much that is new. He establishes a new family Chiphoridæ with two new genera *Streptoconus* and *Hypodictyon*, and another new family Staurorrhaphidæ with two new genera *Achramorpha* and *Megapogon*, and the sub-genus *Grantiopsis*. Two other new genera are established — *Teuthrenodes* among the Sycettidæ, and *Dermatreton* among the Grantiidæ.

Antarctic Sponges.‖—R. Kirkpatrick reports on the 'Discovery' collection of Tetractinellids (four species of *Craniella* and *Cinachyra*), and Monaxonellids (twenty-two new species and four new genera). He describes some new and interesting forms of spicules, e.g. the shuttle-shaped chelæ of the new Mycaline genus *Cercidochela*. Some of the records of antarctic distribution are striking, e.g. *Sphærotylus capitatus* (Vosmaer), an arctic form which has not been obtained from any intermediate station; *Stylocordyla borealis* (Lovén), recorded from the North Sea, which has been found in several intermediate localities; *Esperiopsis villosa* Carter, a northern form, not recorded from any intermediate station except deep-water off the Azores.

New Genera of Pharetronid Sponges.¶—R. Kirkpatrick describes *Minchinella lamellosa* g. et sp. n. and *Merlia normani* g. et sp. n. The

* Journ. Linn. Soc. (Zool.) xxxi. (1908) pp. 80-5 (1 pl.).
† Arkiv Zool., iv. (1908) No. 20, 6 pp.
‡ Zool. Anzeig., xxxiii. (1908) pp. 529-36 (5 figs.).
§ Nat. Antarctic Exped. (Zool.) iv. (1908) 49 pp. (12 pls.).
‖ Tom. cit., 56 pp. (19 pls.).
¶ Ann. Nat. Hist., ii. (1908) pp. 503-14 (3 pls.).

former is a millepore-like form, obtained by the 'Challenger' off Api, New Hebrides; the other formed thin crusts on debris collected near Madeira.

The genus *Minchinella* is thus defined: lamellar Lithoninæ, with pore-chimneys on one side and oscular chimneys on the other, each with a skeleton of monaxons, triradiates, and quadriradiates; main skeletal framework formed of large quadriradiates cemented together. Canal system leuconoid.

For *Merlia* a new sub-family (Merlinæ) is proposed:—Pharetronidæ, in which the solid skeletal framework is constructed of vertical main beams of fibrillar cement, from each of which there radiate three vertical flanges to meet similar flanges from other columns, so as to form cylindrical tubes; the latter are partitioned off by horizontal floors, a honeycomb-like structure resulting. Solid framework without axial core of spicules. In Lithoninæ the framework is constructed on the "béton armé" principle; in Merlinæ the "béton" is not "armé," the axial stiffening of spicules being dispensed with. In *Merlia* the dermal membrane is supported by tufts of slender tyles and with raphides, and tuning-fork spicules are present.

Fresh-water Sponges in Scotland.*—N. Annandale gives descriptive notes on *Spongilla lacustris* and *Tubella pennsylvanica*, the only two species that he is sure of as occurring in Scotland.

Protozoa.

New Rhizopods.†—E. Penard describes three new species from Swiss lakes—*Difflugia histrio*, *Cyphoderia myosurus*, *Heliopera sabauda*, *Difflugia truncata*‡ from a marsh near Geneva, which, when it encysts, forms a diaphragm pierced in the middle and raised on a collaret.

Foraminifera from Coast of Delos.§—H. Sidebottom reports on recent Foraminifera from Delos, and describes two new species of *Spirillina* and two of *Discorbina*.

Peridinians of the Bay of Hougue.‖—E. Fauré-Fremiet gives a descriptive account of this part of the plankton, establishing several new species—*Glenodinium* (1), *Peridinium* (5), a genus which he divides up into groups of species, and *Gonyaulax* (1). He also deals with some of the Ciliata, including *Amphorella jorgenseni* sp. n.

New Flagellate in Congo Flies.¶—E. Roubaud found in the gut of *Pycnosoma putorium* a Flagellate which he regards as a new species of *Leptomonas* (*L. mirabilis*). It occurs in three forms: (1) giant forms (often over 200 μ), drawn out posteriorly into a long filament; (2) minute young forms; and (3) trypanosome-like forms.

* Journ. Linn. Soc. (Zool.) xxx. (1908) pp. 244–50.
† Rev. Suisse Zool., xvi. (1908) pp. 441–71 (1 pl.).
‡ Tom. cit., pp. 472–82 (1 pl.).
§ Mem. and Proc. Manchester Lit. and Phil. Soc. lii. (1908) pp. 1–28 (5 pls.).
‖ Ann. Sci. Nat. (Zool.) vii. (1908) pp. 209–40 (2 pls. and 22 figs.).
¶ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 1106–8 (11 figs.).

Life-history of Glaucoma scintillans.*—S. Prowazek describes the complex process of division, the occurrence of conjugation, the formation of three reduction-nuclei, and other events. After conjugation there is at first very slow multiplication, and many die. Conjugation does not increase the activity of the process of division, but regulates the internal economy of the cell.

Trypanosoma congolense.†—A. Laveran gives an account of this species, found by Broden in the Congo Free State in ass, sheep, cattle, and dromedaries. It is marked by its minute size and by the absence of a free portion of the flagellum. It comes nearest *T. dimorphon*, from which Laveran distinguishes it.

Alleged Autogamy of Bodo lacertæ.‡—C. C. Dobell has studied organisms in the frog which are closely similar to stages in the life-cycle of *Bodo lacertæ*, as described by Prowazek. But they are really yeasts, which have been mistakenly included in accounts of the life-cycle of *Bodo*, and have given basis to the conclusion that autogamy and chromidia occur in this organism. This, according to the author, is still unproven.

New Schizogregarine from an Ascidian.§—Annie Porter describes *Merogregarina amaroucii* g. et sp. n., parasitic in the alimentary tract of a compound Ascidian, belonging to the genus *Amaroucium*. The trophozoite is non-septate, ovoid, possessing a small definite epimerite which is shaped like the head of a lance. Myonemes are present anteriorly. Schizogony is intra-epithelial, the schizonts being numerous, but the number of merozoites produced by each are relatively small. Sporogony occurs in the lumen of the gut, the spores being octozoic.

* Zool. Anzeig., xxxiii. (1908) pp. 277–9 (8 figs.).
† Ann. Inst. Pasteur, xxii. (1908) pp. 833–5 (3 figs.).
‡ Biol. Centralbl., xxviii. (1908) pp. 548–55 (7 figs.).
§ Arch. Zool. Expér. ix. (1908) Notes et Revue, No. 2, pp. xliv.–viii.

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Aleurone Grains.*—J. Beauverie has studied aleurone grains with special reference to the nitrogenous substratum of the mineral salts of the globoids. The author has proved that the substance of the globoids can exist apart from aleurone grains in the integuments and other tissues of maturating seeds, and in some cases he has found granules of the same substance in the cytoplasm and between the cells. The experiments seem to show that these granules are of the same nature as the metachromatic corpuscles found in the lower animals, and belong to the class of substances known as volutins, which are akin to fats, hydrocarbons, etc., but contain nitrogen and phosphorus in addition to carbon, hydrogen, and oxygen. Thus it would appear that the present work confirms the hypothesis which regards the nitrogenous substance of globoids as reserve food-materials.

Structure and Development.

Vegetative.

Seedling of Ceratozamia.†—H. A. Dorety has studied the seedling anatomy of *Ceratozamia*, and her conclusions are as follows. *Ceratozamia* has two cotyledons, one of which aborts. The persisting cotyledon has many bundles, and is often lobed at the apex. Mesarch wood is found in the lower portion, and exarch wood in the upper part. Mucilage-ducts are often found between the bundles. The wood of the leaf-traces is endarch in the central cylinder, but is mesarch from the leaf-base outwards. The primary portion of the vascular cylinder may be a protostele. Several layers of extrafascicular cambium are present, but in two years there is only a very slight trace of anomalous thickening. The root, which is of late development, has a complete ring of cambium around its xylem.

Secretory System of Ginkgo.‡—A. Sprecher has examined the root, stem, petiole, leaves, bracts and floral axes of *Ginkgo* in order to investigate the origin of the secretory system. The root has no secretory cells, but the author finds secretory sacs in the pith and primary cortex of the stem and petioles, and also in the leaves and older female floral axes. The largest sacs are developed in the bases of the young ovules and stamens. There are no secretory canals such as occur in other Conifers, but the whole system appears to resemble that of the Marattiaceæ in its

* Ann. Sci. Nat., ser. 9, viii. (1908) pp. 147–75 (2 pls.).
† Bot. Gaz., xlvi. (1908) pp. 203–20 (5 pls. and 2 figs.).
‡ Beih. Bot. Centralbl., xxiv. (1908) pp. 68–82 (2 pls. and 19 figs.).

mode of formation. The author still maintains his opinion that the secretory cells of *Ginkgo* are mainly, if not entirely, lysigenous in origin.

Anatomy of Embryo of Cannaceæ and Musaceæ.* — C. L. Gatin has studied the embryology and germination of the Cannaceæ and Musaceæ, and finds that in both cases the embryos are remarkable for their advanced state of differentiation. Their radicle is less endogenous than that of the palms, being least so in *Strelitzia*, where the piliferous layer is continuous with the subepidermal layer of the embryo. *Heliconia*, however, has a very poorly differentiated embryo, and the central cylinder is differentiated before other parts of the radicle, thus approaching the palms more nearly than the other Musaceæ. The cotyledon is much larger than in the palms owing to the greater size of the individual cells. There are two phases in germination : (1) the elongation of the cotyledon ; (2) germination proper. The arrangement of the cotyledonary bundles does not favour the views of those writers who regard the single cotyledon as derived from the fusion of two ancestral cotyledons.

Adventitious Roots of Dicotyledons.† — Dr. Noll contributes a short note upon the adventitious root-system of Dicotyledons. The theory which regards the acropetal succession of rootlets as the rule among Dicotyledons, appears to be untenable in the light of the present work. The presence of an adventitious root-system has been proved to exist in *Helianthus*, *Ricinus*, *Cucurbita*, and the female plant of *Cannabis*, and the author is of the opinion that an adventitious root-system may be as readily developed among Dicotyledons as among Monocotyledons when the disproportion between the aerial portions of the plant and its root-system renders such development necessary, but that while in Monocotyledons the adventitious root-system will be in connection with the growing stem, in Dicotyledons it will be connected with the root.

Leaf-structure of Sand-dune Plants of Bermuda.‡—J. W. Harshberger describes the sand-dune plants of Bermuda, with special reference to the modification of leaf-structure. The most important ecological factor appears to be the bright illumination from above, and the reflection of light from the white sand below, and the light stimuli have produced changes in both the form and the structure of the leaves. The most important modifications include thick cuticle in *Nerium Oleander*, *Conocarpus*, etc. ; thick epidermis in *Canavalia*, *Dodonæa*, *Ipomœa pes-capræ*, etc. ; two or three epidermal layers in *Conocarpus*, *Croton*, etc. ; several rows of palisade-cells in *Passiflora*, *Conocarpus*, etc. ; depressed stomata in *Sisyrinchium*, *Sesuvium*, etc. ; stomata in pits in *Lantana* and *Nerium* ; succulent leaf in *Sesuvium*, *Conocarpus*, etc. ; hairy leaf in *Borrichia*, *Tournefortia*, etc. ; varnished leaf in *Dodonæa* ; erect position of leaf in *Stenotaphrum*, etc. ; overlapping leaves in *Euphorbia*, etc. ; latex-tissue in *Euphorbia* ; gum-resin in *Conocarpus* ; crystals in *Croton*, etc. ; modification of mesophyll in many genera, including *Ipomœa*, *Passiflora*, *Conocarpus*, etc.

* Ann. Sci. Nat., ser. 9, viii. (1908) pp. 113–46 (2 pls. and 34 figs.).
† S.B. Natur. Ver. Rheinl., ii. (1907) pp. 54–7.
‡ Proc. Amer. Phil. Soc. xlvii. (1908) pp. 97–110 (3 pls.).

Anatomy of the Geraniaceæ.*—A. Legault has studied the anatomy of the vegetative organs of the Geraniaceæ, and finds that they exhibit certain peculiarities which confirm the classification based upon the morphology of the fruit and flower, and even in some cases are sufficient of themselves for identification of a given plant. Moreover, in certain instances, affinities are discovered which are not indicated by the external morphology—e.g. the anatomy of *Monsonia* indicates a closer relationship between that genus and *Pelargonium* than between it and *Erodium*. The present paper gives strong support to the opinion that classification should be based not merely upon external morphology, but also upon the characters of the internal structure.

Reproductive.

Embryology of Gnetum.†—J. M. Coulter has studied the embryo-sac and embryo of *Gnetum gnemon* with the following results. The "antipodal tissue" proves to be nutritive tissue formed from the nucellus below the embryo-sac. Embryo-formation starts with the elongation of the fertilised egg, accompanied by free nuclear divisions and wall-formation, which continues until a multicellular embryo is formed. The endosperm encroaches irregularly upon the nuclear beak. There are 12–24 chromosomes. The inner integument of the ovule corresponds to the "inner fleshy layer" found among those Gymnosperms having only a single integument. There are two sets of vascular strands, a condition which appears to be more primitive than that found in the Coniferales and Ginkgoales.

Male Cone and Gametophyte of Podocarpus.‡—L. L. Burlingame has examined the male cone and gametophyte of *Podocarpus*, and confirms the observations made by Coker, Jeffrey, and Chrysler, at the same time showing that the phenomena observed by them are common to other species. The two species examined—viz. *P. totarra* var. *Hallii* and *P. nivalis* have two prothallial cells which may or may not divide. The primary cells may give rise to as many as eight prothallial cells. The prothallial cells show mitosis, and do not degenerate. Both stalk and body-cells are found, but it is uncertain whether they produce male-cells. There are 12 and 24 chromosomes. At the time of shedding, the pollen-grain contains a variable number of cells, or free nuclei. The author regards *Pinus* and *Podocarpus* as derived from a common ancestral stock, assuming that in one case the prothallial complex has been retained, while in the other case it has been lost.

Structure of the Pistil, Ovule, Fruit, and Seed of Acanthaceæ.§ Ph. van Tieghem records the results of his investigation on this family. In the species of *Thunbergia* examined, a vascular bundle ascends the septum between the cells comprising the ovary, and these trifurcate, the middle branch running up the style, while the lateral ones curve outwards and penetrate slightly into the ovule, where they stop without branching. The single coat of the ovule is very thick, and the micro-

* Comptes Rendus, cxlvii. (1908) pp. 382–4.
† Bot. Gaz., xlvi. (1908) pp. 43–9 (1 pl.).
‡ Tom. cit., pp. 161–75 (2 pls. and 9 figs.).
§ Ann. Sci. Nat. ser. 9, vii. (1908) pp. 1–24.

pyle, long and very straight, is directed obliquely downwards and opens over against the septum. The narrow transitory nucellus is entirely absorbed before the flower opens, to be replaced by a slender female prothallus, having its summit at the bottom of the micropyle, and its base near the end of the vascular bundle, from which it is separated by a "hypostase" in the form of a thick cup composed of thin-walled lignified cells. The ovule, having no trace of a raphe, is neither anatropous nor amphitropous, but belongs to the campylotropous group. The fruit is a globose bilocular capsule, with four seeds, and a beaked upper portion. This capsule opens from above downwards loculicidally, and since the septum also splits, its dehiscence is also septifragal. The seeds are set free by the formation of a ring of thick, lignified epidermal cells at the rim of the large sunk hilum, which ring presses against the septum, and effects separation. The cotyledons are incumbent, and contain aleurone and oil, without starch. *Nelsonia* has approximately the same structure, as also *Mendoncia*, except that in the latter, the fruit being a drupe, no separating ring is formed by the seed. These genera the author unites into a group, which he provisionally calls the Thunbergieæ. The ovary of species of *Acanthus* (*mollis*, *longifolius*, *spinosus*) has a very thick septum, each half of which differentiates in its interior two laminæ, perpendicular to the surface, formed of very long, straight, thin-walled cells containing mucilage, but none of the starch which abounds in the rest of the septum. This is certainly not conducting tissue for the pollen-tubes, and its function is at present doubtful; in the capsule stage this tissue is seen to be lignified. The two ovules of each cell are borne by a short, thick, obliquely ascending funicle, and are flattened in a plane parallel to that of the septum. Each receives a vascular bundle from the septum, which bundle traverses the funicle and ends at once in the ovule in the shape of a horse-shoe, due to the phloem of the bundle reaching higher on each side than the xylem. The integument of these ovules is very thick and wholly cellular, and invests before the flower opens a straight nucellus, soon replaced by a female prothallus of the same form. Here also there is a "hypostase." The prothallus grows out and curves until it reaches the bottom of the micropyle, and continuing its curvature thence it buries itself in the integument on the opposite side of the ovule, in contact with a rounded mass of small cells with thickened collenchymatous walls and starchy contents destined to serve as nutritive tissue to the embryo, since they gradually become dissociated and absorbed, much as happens with the nutritive nodules produced by the placenta of the Utricularias. These ovules are strictly campylotropous, as also are the ovules, showing the same essential structure, of species of *Whitfieldia*, *Justicia*, *Ruellia*, *Aphelandra*, and other genera. These genera are ranged in a second group called Acantheæ. The author regards the retinaculum as simply a dorsal emergence from the funicle, and thus comparable to a partial aril, differing from the normal aril in that it is not detached with the seed. The rest of the memoir is of systematic interest. Unfortunately there are no illustrations, an omission detracting seriously from the value of the contribution. The author suggests the division of the family into two distinct families, Thunbergiaceæ and Acanthaceæ.

Physiology.

Nutrition and Growth.

Transpiration in Plants.*—G. F. Freeman has experienced some difficulty in physiological and ecological work connected with plant-breeding in finding an accurate and practical method of measuring transpiration. The potometer does not record the normal rate of plant-transpiration, neither can it be made to show the comparative transpiration of different plants. By modification and adaptation of the methods of Lamarlière and E. and J. Verschaffelt, the author has been able to measure accurately the transpiration of plants under known and constant conditions. Moreover, individual differences in the transpiration rates of different plants can be measured, and the apparatus may be used with advantage in plant selection and breeding. The most important differences between the new and the old form of apparatus are the use of a different absorbent, the modification permitting of the measurement of transpiration of plants still attached to their own roots and the supply of normal air.

Irritability.

Gravitation-sensitiveness of Root.†—F. C. Newcombe has experimented upon *Zea Mays*, *Lupinus albus*, *Pisum sativum*, *Phaseolus multiflorus*, *Vicia Faba*, *Ricinus communis*, and *Cucurbita pepo*, and is of the opinion that there is no proof that gravitation-sensitiveness is limited to the apical 2 mm. of the root. Centrifugal experiments show that sensitiveness extends backwards as far as 2·5 mm., and in some species more than 4 mm. The geotropic curve described by an orthotropic root displaced from its normal position is dependent upon the relation between its geotropism and autotropism. Frequently the autotropism of such displaced roots prevents the seedling from sending roots vertically downwards. The length of the elongating zone does not appear to be related to the extent of the sensitive zone.

Influence of Aluminium Salts on Protoplasm.‡—M. Fluri has experimented upon *Spirogyra*, *Elodea*, *Lemna*, etc., in order to test the influence exerted by salts of aluminium upon protoplasm. The experiments show that the process of assimilation is retarded, but not inhibited, by the presence of sulphate, nitrate, chlorate, and bichromate of aluminium. Also, the cells become permeable to substances which do not usually pass through the cell-walls, but the amount of the substances which thus enters the protoplasm is too small to be detected by usual chemical tests. Streaming of the protoplasm continues, but is less rapid than under normal conditions. The effects produced by the aluminium salts are neutralised by glucose, glycerin, and isodulcit, but are unaffected by salt or nitre.

MARTEL, E.—**Contribuzione all' anatomia de fiore dell' Hedera Helix, dell' Aralia Sieboldii e del Cornus sanguinea.**

[An anatomical study of the flowers of these three species, with special reference to vascular tissue relations.]

Mem. Reale Accad. Sci. Torino, lviii. (1908) pp. 561–76 (1 pl.)

* Bot. Gaz., xlvi. (1908) pp. 118–29 (1 fig.).
† Beih. Bot. Centralb, xxiv. (1908) pp. 96–110 (1 pl. and 3 figs.).
‡ Flora, xcix. (1908) pp. 81–126.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

Phylogeny and Inter-relationships of Pteridophyta.*—I. Browne has begun a series of articles intended to place before the student a brief critical account of the principal views now held as to the phylogeny and affinities of the Vascular Cryptogams. The inter-relationship of the various types composing each phylum will be successively considered, and later on the affinities of the phyla to one another. The members of the fossil Sphenophyllales form the subject of discussion in the first article, the Equisetales in the second, the Lycopodiales (Lepidodendraceæ, Isoëtaceæ, Selaginellaceæ, and Lycopodiaceæ) in the third and fourth. At the end of each article is a bibliography of the papers cited.

Absence of Foliar Gaps in the Lycopsida.†—E. C. Jeffrey published six years ago an account of his studies on the stem of the Pteridophytes and Gymnosperms, and expressed the view that there are two types of tubular central cylinder, namely, that in which only ramular gaps are present, and that in which both ramular and foliar gaps occur. Further, he stated that the Vasculares are divided into two great primitive stocks: (1) the Lycopsida, which are cladosiphonic and palingenetically microphyllous; and (2) the Pteropsida, which are phyllosiphonic and palingenetically megaphyllous. The Lycopsida include the Lycopodiales and Equisetales. The Pteropsida include the Filicales, Gymnospermæ, and Angiospermæ. These two great stocks appear to have been separate back to the beginning of the period when the palæontological record begins. To this hypothesis various objections have been raised during the interval that has elapsed, but they give the author no reason for modifying his standpoint in any essential feature. In the present paper he shows that some of the objections to the Lycopsida arose from misapprehension, etc. After replying to his critics, he sums up as follows:—(1) True foliar gaps occur immediately above their corresponding leaf-traces, and are not lateral to the leaf-traces; (2) true foliar gaps are absent in *Phylloglossum*; (3) they are likewise absent in *Tmesipteris*; (4) they are absent in the Lepidodendreæ and the Sigillariæ; (5) they are unquestionably absent in the cone axis of *Equisetum*, and on the basis of comparative anatomy are absent also in the vegetative stem: similar statements apply to the reproductive and vegetative axes of *Calamites*; *Archeocalamites* has no foliar gaps in its vegetative stem; (6) the Lycopsida, as defined by the author, are clearly marked off from other plants by a palingenetically microphyllous habit, the absence of foliar gaps in the tubular stele, and by the possession of sporophylls with adaxial sporangia. They constitute a great natural phylum. It should be added that in *Phylloglossum* and *Tmesipteris* perforations in the tubular stele sometimes

* New Phytolog., vii. (1908) pp. 93–113, 1"0–66, 181–97.
† Bot. Gaz., xlvi. (1908) pp. 241–58 (2 p's).

occur laterally situated with respect to the outgoing leaf-traces, and these have been misinterpreted as foliar lacunæ. The same applies to the more modern species of Sigillariæ.

Nature of the Tracheæ in Ferns.* — D. T. Gwynne-Vaughan, having examined the xylem of some of the recent ferns, has come to the conclusion that the xylem elements of the Pteridophyta are, for the most part, vessels with true perforations in their longitudinal as well as in their terminal walls; that in the Osmundaceæ, *Nephrodium filix-mas*, and probably others, a special type of vessel occurs which is characterised by the complete disappearance of the primary tracheal wall at certain points, so that the cavities of the pits are vertically continuous in the middle of the wall. It is probable that more or less rounded pits preceded the transversely elongated pits of the scalariform type in the Filicales.

Vascular System of the Filicineæ.†—A. G. Tansley brings to an end the publication of his lectures on the evolution of the filicinean vascular system. In Lecture ix. he makes a general survey of the leaf-trace in the Filicineæ, the comparative treatment of which subject we owe to Bertrand and Cornaille and to Gwynne-Vaughan. The rest of the lecture is concerned with the ontogeny of the filicinean vascular system. In Lecture x., Tansley makes a comparison of the vascular system of the ferns with that of other phyla of vascular plants, compares the morphological construction of *Selaginella* with that of other ferns, and finally gives a brief comparison of the ferns with the Cycadofilices which lead up to the Cycadophyta and the flowering plants. A glossary is appended to define the principal terms employed in these lectures, relating to the construction of the stelar system. Titles of 37 works are given in the bibliography.

Sporangiophore in the Pteridophyta.‡—M. Benson passes under review the different types of sporangiophore found among the Pteridophytes, fossil and living. She discusses the morphological value of the sporangiophore, and concludes as follows:—On the whole, a review of the great central phylum, Pteridophyta, as a group of plants derived from a common ancestor, whose sporophyte generation bore a special type of asexual spore-producing organ called a sporangiophore, seems illuminating and possibly useful as tending to concentrate attention on the probable origin of the structure in question.

Cavity Parenchyma and Tyloses in Ferns.§—M. McNicol gives a résumé of what has been written about cavity parenchyma and tyloses found in contact with the protoxylem groups in the petioles of some ferns, and describes what she has herself observed of this tissue in a number of ferns, for example, in *Microlepia*, *Pteris*, *Alsophila*, *Dicksonia*, *Cibotium*, *Marsilia*, and others. In discussing its function, she says that cavity parenchyma is to be regarded as a special tissue formed by the

* Ann. of Bot., xxii. (1908) pp. 517–23 (1 pl.).
† New Phytolog., vii. (1908) pp. 1–16, 29–40 (figs.).
‡ Tom. cit., pp. 143–9 (figs.).
§ Ann. of Bot., xxii. (1908) pp. 401–13 (1 pl.).

conjunctive parenchyma cells of the vascular bundles of the petiole, which replaces the first-formed elements of the wood, sometimes by simply crushing the spiral vessels, but generally by means of tylose-like swellings within the cavity of the vessels. True tyloses are unknown in recent Vascular Cryptogams, save in two rare cases. As regards the pseudo-parenchyma in the tracheids of fossil ferns, for example, in the petiole of *Rachiopteris insignis* (*Zygopteris corrugata*), the evidence that it is composed of fungal hyphæ, is at least as strong as that it is a true process of tylosis.

Abnormality in Psilotum triquetrum.*—M. G. Sykes describes and figures an abnormal sporangiophore structure noticed on a dried specimen of *Psilotum triquetrum* from New South Wales. Some distance below the apex there occurred, among the ordinary synangia, a cluster of four synangia borne together on a common stalk. Three of these synangia were bilocular, while the apical or terminal one was unilocular. The two lower synangia were subtended each by a double bract, the third synangium by a single bract, and the apical by no bract. She is inclined to regard it rather as derived from a single proliferated synangium-bearing appendage than as equivalent to a normal aerial branch abortive in development.

Structure of a Branch Cone in Equisetum.†—W. Stiles describes the structure of an abnormal cone of *Equisetum maximum* in which branching of the strobilus had occurred. The most interesting feature was the presence of vascular bundles in the pith of the main axis, quite unconnected with the normal ring of vascular tissue, and having a structure different from that of the normal bundle. It is possible that these medullary vascular strands may be the remnants of the solid central stele of the ancestors of the living species of *Equisetum*.

Origin of the Sphenophylleæ.‡—O. Lignier in 1903 attributed to the Equisetales and Sphenophyllales a Filicinean origin. In reply to objections urged by Scott and Sykes against this view, Lignier now reaffirms his position with additional argument. The "fertile leaves" of *Sphenophyllum* cannot be homologised with the sporangiferous structures of *Tmesipteris*; but their "sterile pinnules" are comparable with those of *Archæopteris*. The "fertile pinnules" are of the same type as those of the Primofilices. Hence Lignier concludes that the Sphenophylleæ should be attached to the Primofilices, and not to the Lycopodiales.

Fossil Ferns.—F. Weiss § publishes an abstract of a paper on the morphology of *Stigmaria* and of its appendages in comparison with recent Lycopodiales.

R. Kidston and D. T. Gwynne-Vaughan‖ publish a second article on the fossil Osmundaceæ, describing the anatomy of a new genus *Zalesskya* with two species.

* Ann. of Bot., xxii. (1908) pp. 525-6 (figs.).
† New Phytolog., vii. (1908) pp. 113-16 (figs.).
‡ Bull. Soc. Bot. France, iv. (1908) pp. 278-88. See also Bot. Gaz., xlvi. (1908) p. 319. § Proc. Linn. Soc., 1907-8, pp. 74-5.
‖ Trans. Roy. Soc. Edinburgh, xlvi*a*. (1908) pp. 213-32 (4 pls.).

Use of Collodion Casts of Fossil Ferns.*—A. G. Nathorst describes a method of making collodion impressions of the surface of fossil plants for examination under the Microscope. He illustrates his article with photographs of such casts, showing the structure of the sporangia of fossil ferns, the epidermis of fern-fronds, etc.

Prothallium of Lycopodium complanatum.†—H. Bruchmann gives a detailed account of the prothallium of *Lycopodium complanatum*, illustrated by 47 figures. He describes the structure of the prothallium, its occasional multiplication by means of vegetative offshoots, the sexual organs, and the development of the embryo.

Prothallium of Kaulfussia and Gleichenia.‡—D. H. Campbell, during his recent visit to Java, obtained material the study of which has enabled him to give a detailed account of the prothallia, reproductive organs, and embryo of *Kaulfussia* and *Gleichenia*. The prothallium of *Kaulfussia* is large, and always contains an endophytic fungus. The antheridia and archegonia are large, and are borne on the ventral surface. All the organs of the embryo except the foot are of epibasal origin. The shoot pierces through the prothallium and emerges on the dorsal side.

The prothallium of *Gleichenia* is of the "massive-midrib" type, lobed, and containing an endophytic fungus. The antheridia are restricted to the ventral surface, except in *G. lævigata*. They are in the Javan species larger and more complex than described by Rauwenhof. The archegonia are borne chiefly on the sides of the "midrib," and are long-necked. The embryo apparently resembles that of the Polypodiaceæ. In sporelings the characteristic protostelic condition was observed.

Effect of Different Light-rays on Prothallia.§—A. Burgerstein describes the effect of light-rays of different refrangibility upon the formation of fern-prothallia. He gives a résumé of the determinations of previous authors, and states that as the result of his own experiments he finds that under the influence of the blue rays the prothallia generally form themselves in from a few days to weeks later (never earlier) than under the influence of rays of lower refrangibility; and he appends a table of differences.

British Ferns.‖—E. Step has prepared a pocket guide to the British ferns and fern-allies—an addition to his series of Nature handbooks. After a general introduction, the species are treated separately. Each species is represented by coloured figures, and several photographs showing the plants in their natural habitats are reproduced. A classified index to the families, genera, and species is added.

Pteridophyta of the French Mediterranean Basin.¶—W. Herter gives an account of the Pteridophyta of the French basin of the

* Arkiv Bot., vii. No. 4 (1908).
† Bot. Zeit., lxvi. (1908) pp. 169–81 (figs.).
‡ Ann. Jard. Bot. Buitenzorg, ii. (1908) pp. 69–102 (8 pls.). See also Bot. Gaz., xlvi. (1908) pp. 313–14.
§ Ber. Deutsch. Bot. Gesell., xxvi*a*. (1908) pp. 449–51.
‖ Wayside and Woodland Ferns. F. Warne and Co., 1908. 143 pls.
¶ Bull. Herb. Boiss., viii. (1908) pp. 794–820.

Mediterranean, comprising 49 ferns and 24 fern-allies. He treats them analytically, first arranging them in systematic order and stating their general distribution. Then by means of lists he shows their distribution (1) in the different zones of altitudes; (2) according to the physical nature of the soil; (3) according to the chemical nature of the soil; (4) according to the humidity of the surrounding air; (5) according to the intensity of solar illumination; (6) according to the temperature of the surrounding air. And further, he shows in a table the comparative frequency of each species in the five zones of altitude.

Ferns of Styria.*—A. von Hayek issues the first part of his flora of Styria, a work which will comprise about 18 parts, more than 1400 pages, and will treat of the vascular plants of the province and the geographical relations of the flora. The present part consists almost entirely of an account of the ferns and fern-allies. A series of well-defined keys to the various groups, genera, and species is supplied. The descriptions (in German) are concise. Synonymy and the citation of literature are sufficiently fully treated, while the habitat and distribution of the species have been prepared with much care. Some of the groups are illustrated with text-figures.

Ferns of Mount Ruwenzori.†—R. Pirotta publishes diagnoses of four new ferns collected on Mount Ruwenzori at an altitude of about 12,000 ft. during the expedition of the Duke of the Abruzzi. Their names are *Cyathea Sellæ*, *Woodsia nivalis*, *Asplenium Ducis-Aprutii*, *Elaphoglossum Ruwenzorii*.

Ferns of the Malay Peninsula.‡—H. N. Ridley publishes a list of more than 380 species of ferns recorded as occurring in the Malay Peninsula, a region particularly rich in ferns owing to its wet tropical forests. The richest localities are usually situated at altitudes of 1000–5000 ft. Most of the species occur also in the Malay Islands, many also in the Mascarene Islands, as well as in India, Polynesia, and South America. Six even are found in the British Isles. About 40 of the species are endemic in the Malay Peninsula. Notes on the habitats and uses of the ferns are added. The local distribution, collector's name, number, and native name are given under each species.

Ferns of Argentina.§—C. Hicken publishes some notes on Argentine ferns. He gives a list of twenty-three; among these are two species and two varieties described for the first time.

BORNMÜLLER, J.—**Flora der Elbursgebirge Nord-Persiens.** (Flora of Mount Elburz, in North Persia.)
[Contains a list of thirteen ferns and three fern-allies.]
Bull. Herb. Boiss., viii. (1908) pp. 830–2.

KIRK, G. L.—**New Stations for Ferns in Vermont.**
[Describes the nature of a bog in which were found *Woodwardia virginica* and *Osmunda cinnamomea* var. *incisa*.] *Rhodora*, x. (1908) p. 196.

* Flora von Stiermark. Berlin: Borntraeger, I. i. (1908) pp. 1–80 (figs.).
† Annali di Bot., vii. (1908) pp. 173–4.
‡ Journ. Roy. Asiat. Soc., Straits Branch, No. 50 (1908) 59 pp.
§ Trab. Museo Farmacol. Facult. Cienc. Med. Buenos Aires, No. 19 (1907) 12 pp.

Bryophyta.

(By A. Gepp.)

Phylogeny of the Archegoniatæ and of the Characeæ.* — H. Schenck treats of the unsolved problem of the origin of the Archegoniatæ. He discusses the commonly held view that in the green algæ, and especially in *Coleochæte*, the ancestry of the Archegoniatæ may be sought, and the objections that weigh against this theory. Setting aside the red algæ, as affording no clue, he passes on to a consideration of the brown algæ, which have been already suggested by Potanié, Hallier, and others. He points out that in *Dictyota* we find, for the first time among the Thallophytes, the same form of regular alternation of generations which prevails in the Archegoniatæ. And by a comparison of the reproductive organs, the author shows that the antheridia and archegonia of the mosses and ferns are homologous with the plurilocular gametangia of the brown algæ, and that the spore-mother-cells of the mosses and ferns find their homologue in the tetrasporangia of *Dictyota*. In the vegetative organs, also, are many indications of relationship between the brown algæ and the Archegoniatæ. Similar hints of a relationship between the Characeæ and the brown algæ are discernible.

Reduction and Fertilisation in Polytrichum.†—J. and W. Docters van Leeuwen-Reijnvaan describe the development of the sexual organs in four common species of *Polytrichum*, the double reduction that occurs in the process, and the fertilisation of the egg by two antherozoids. In the antherozoidal cell a small portion cut off from the nucleus passes out into the cytoplasm and forms two centrosomes, and after the mitosis becomes taken up again. A small piece of chromatin is cut off, wanders to the periphery of the cell, and becomes a blepharoplast. At the same time a large piece of chromatin is cut off, extruded into the cytoplasm, and gradually degenerates. In the sporogenous cells are seen 12 chromosomes: 4 long, 4 short, 4 medium. In the gametophyte are found 6 chromosomes: 2 long, 2 short, 2 medium. Owing to a longitudinal fusion in pairs, the chromosomes in the antherozoids are reduced to 3: 1 long, 1 short, 1 medium. The central cell and the ventral canal cell of the archegonium each contain 3 chromosomes: 1 long, 1 short, 1 medium. These two cells fuse together, and the resulting egg is fertilised by two sperms. It thereupon contains 12 chromosomes. The authors consider that the individuality of the chromosomes is especially clearly indicated in *Polytrichum*.

The same authors ‡ publish another paper, which treats of the spermatogenesis of mosses, with special reference to questions of centrosomes and reductions in nuclear division. The material investigated for centrosomes was *Pellia*, while the reduction of chromosomes was studied in *Polytrichum* and *Mnium*.

Sexual Differentiation in the Spores of Fegatella.§—A. F. Blakeslee gives an account of some experiments, which demonstrate that the sporogonium of the dioicous hepatic *Fegatella* produces both male and

* Engler's Bot. Jahrb., xlii. (1908) pp. 1–37.
† Rev. Trav. Bot. Néerland, iv. (1908) pp. 177–220 (2 pls.).
‡ Ber. Deutsch. Bot. Gesell., xxvi*a*. (1908) pp. 301–9.
§ Bot. Gaz., xlvi. (1908) pp. 384–5.

female spores, just as has been previously shown to be the case in some other dioicous plants, namely, in *Marchantia* (by Blakeslee), and in *Barbula unguiculata*, *Bryum argentium* and *Ceratodon purpureus* (by El. and Em. Marchal).

Structure of Mosses in Relation to Habitat.*—A. J. Grout publishes notes upon some relations between the habitats of mosses and their structure. Species that grow upon tree-trunks have erect capsules, so, too, those that grow on the faces of cliffs; and these erect capsules very rarely have complete double peristomes. The double peristome is a device for preventing the too rapid escape of spores from pendent capsules. There seems to be some relation between the annual cleistocarpous mosses and their habitat, moist bare soil. Again, mosses of xerophytic habit have small cells and very thick walls, a further protection against desiccation being sometimes added in the form of large papillæ on the surface of the cells. Pleurocarpous mosses that grow on the bark of trees and in similar xerophytic habitats are remarkable for the large number of quadrate thick-walled alar cells in their leaves. On the other hand, the alar cells of aquatic or subaquatic pleurocarpous species tend to become enlarged and inflated, the other leaf-cells being exceedingly long and narrow. The meaning of this modification is obscure.

Mosses and Environment.†—A. Geheeb publishes a posthumous manuscript by K. Schimper upon the habitats of mosses and the effect of environment upon them. The author considers the manifold influences that affect mosses and lichens, together with the corresponding differences effected in their morphology.

Resting Periods in Riccia.‡—E. Zacharias publishes some notes on the periodicity of hepatics. He kept under observation in a greenhouse two species of *Riccia*, the common *R. natans* and the Algerian *R. Gougetiana.* The former he observed to die down in the autumn, only a small portion of the apical margin retaining life and resuming growth in the following spring. *R. Gougetiana* on the other hand has its resting period in the summer: having formed an apical bud in the spring it died off, and the bud resumed growth in the autumn.

Abnormal Sporogonia in Mosses.§—I. Györffy describes instances of twin or triplet sporogonia. Such abnormalities have previously been recorded for twenty-three mosses. Györffy adds *Dissodon Froelichianus* and *Plagiobryum demissum* to the list, giving figures and descriptions of the freaks.

Artificial Production of Propagula in Barbula.‖—J. Maheu describes a method for obtaining experimentally the production of propagula without failure in several species of *Barbula*, in which normally they are entirely absent. Broadly speaking, a specially arranged moist chamber was employed, so as to insure a saturated atmosphere. Some of the experiments were made in the light, others in the dark.

* Bryologist, xi. (1908) pp. 97–100.
† Beih. Bot. Centralbl., xxiv. 2te Abt. (1908) pp. 53–66.
‡ Verh. Nat. Wiss. Verein, Hamburg, xv. (1908) pp. lxxv–lxxvi.
§ Magyar Bot Lapok, vii. (1908) pp. 61–74 (pl.).
‖ Bull. Soc. Bot. France, 1908, pp. 445–53 (2 pls.).

Introduction to British Mosses.*—Sir Edward Fry issues a second edition of his little book on British Mosses, which grew out of a lecture delivered by him in 1891 at the Royal Institution, and which forms an introduction to a study of the classification, life-history, modes of reproduction, and structure of mosses, and of the important services they render in nature. In this latter respect, emphasis is laid upon the rôle played by the Sphagnaceæ and their relation with the formation of peat and with the ancient forest-beds. The figures in the present edition have been re-drawn and added to.

Muscineæ of Invernessshire.†—A. Wilson and J. A. Wheldon give a list of seventy-seven species of mosses and twenty-one of hepatics, with numerous varieties collected by them during a brief visit to East Invernessshire during July 1908. The weather being bad prevented them from exploring the summits of the Cairngorm range as they intended ; hence their collections were principally made in the Forest of Rothiemurchus. The authors give a sketch of the vegetation as they found it.

Muscineæ of North Devon.‡—C. E. Larter publishes a note upon the interesting species of Cryptogams found on the north coast of Devonshire in the past year. Among them are eleven mosses and six sphagna and a hepatic new to the county, and four hepatics which have not been found there for more than thirty years.

Distribution of Lunularia in Britain.§—S. M. Macvicar calls for an investigation of the distribution of *Lunularia* in the British Islands. Although this plant, like some other Mediterranean species, may be truly native on our south coast, it has certainly often been introduced with garden plants. Its present distribution ought to be mapped out, its method of extension ascertained, and its effect upon other species (for example, upon *Marchantia*) noted. In the south of Scotland it is widely distributed in gardens, and is abundant in ravines near gardens. It is more rare in the highlands. It grows in profusion in ravines near Edinburgh ; but it was apparently non-existent there in Greville's time, and hence is not mentioned by that observant botanist.

Means of Distribution of Hepaticæ.‖—H. R. Yeates publishes some notes upon the distribution of some thalloid Hepaticæ mostly in the south of England, especially upon *Metzgeria furcata*, *Dumortiera irrigua*, *Lunularia cruciata*, *Marchantia polymorpha*, and *Fegatella conica*. His contention is that these species never, or rarely, succeed in forming spores, and that their rapid propagation is effected by means of detached gemmæ, thallidia, or fragments, normally conveyed by water and rarely by animal agencies. The habitat of such plants is where moisture is abundant.

Rare Scandinavian species of Cephalozia.¶—H. W. Arnell and C. Jensen describe and illustrate some rare Scandinavian species of

* London : Witherby and Co., 1908, 2nd ed., viii. and 72 pp. (40 figs.).
† Journ. Bot., xlvi. (1908) pp. 347–356.
‡ Tom. cit., p. 393.
§ Tom. cit., pp. 382–4.
‖ New Phytologist, vii. (1908) pp. 167–71.
¶ Bot. Not. Lund, 1908, pp. 1–16 (8 figs.).

Cephalozia, including the types of the following species invented by S. O. Lindberg: *C. borealis*, *C. subsimplex*, *C. spinigera*; also *C. lacinulata* (Jack) Spruce, and *C.* (*Prionolobus*) *Perssonii* Jens.

French Mosses.—A. Friren * publishes a fifth account of bryological excursions in Lorraine, with indications of stations for rare mosses.

He also publishes † a fourth supplement to the Catalogue of the Muscineæ of Lorraine, including five mosses and four hepatics new for the province.

J. Maheu and A. Gillet ‡ record the finding of fruiting specimens of *Thuidium abietinum* near Fontainebleau, in a new railway cutting through the limestone. They figure the capsule as erect and straight.

A. Gillet § publishes a contribution to the moss-flora of the mountains of the Tarentaise, giving lists of species for the principal localities.

Philonotis in France.‖—G. Dismier publishes a monograph of the French species of *Philonotis*, based upon the papers of L. Loeske, upon a searching examination of the material preserved in several French herbaria, and upon observations in the field in numerous localities of great diversity in France. He gives a résumé of the principal works published since 1876 which treat of the genus, a bibliography, an explanation of the special descriptive words employed in the monograph, and a key to the species. The species recognised are eight in number, namely, *P. rigida*, *P. marchica*, *P. capillaris*, *P. cæspitosa*, *P. calcarea*, *P. seriata*, *P. fontana*, *P. tomentella*. Each of these is carefully described, with its varieties, and critical notes are added.

French Hepatics.¶—C. Douin gives a list of twenty-four hepatics and twenty mosses collected by him in the very rich district round Sancy, in Auvergne. Among them is a species new to science, *Bryum arvernense*, two species and several varieties new to the French flora, and six or seven new for Auvergne. Some critical notes are included in the paper, and the differences between the following pairs of species are drawn up in parallel columns—*Nardia obovata* and *N. subelliptica*; *Alicularia minor* and *A. insecta*; *Marsupella Sprucei* and *M. ustulata*. Some further interesting gatherings at La Bastide (Cantal) and at Gavarnie are mentioned at the end of the paper. L. Hillier ** records the discovery of *Lejeunea Rosettiana* in the Jura near Besançon, and the station and environment in which he found it. Three times previously it had been gathered in France.

Death of C. Lacouture.††—A. Friren and T. Husnot announce the death of this old bryologist, who in 1905 published some illustrated synoptical tables of the Hepaticæ of France, and in 1908 an analytical and synoptical key (with figures) to the forty odd genera into which the old *Lejeunea* has been broken up. Further he had prepared for publica-

* Bull. Soc. Hist. Nat. Metz (1908) pp. 47–78.
† Tom. cit., pp. 83–90.
‡ Bull. Soc. Bot. France, lv. 1908, pp. 133–8 (figs.).
§ C.R. Congrès Soc. Savantes, 1906, pp. 345–51.
‖ Mém. Soc. Sci. Nat. Cherbourg, xxxvi. (1907) pp. 367–428.
¶ Rev. Bryolog., xxxv. (1908) pp. 131–7.
** Tom. cit., pp. 140–1. †† Rev. Bryolog., xxxv. (1908) p. 145.

tion a larger work on the same plan, namely synoptical tables diagnosing all known genera of hepatics.

Mosses of Bavaria.—A. P. Hammerschmid * publishes a second contribution to the moss-flora of Upper Bavaria, from the neighbourhood of Schliersee, Tegernsee, Tölz, Walchensee and Kochelsee, 1905–7. V. Schiffner † gives an account of the distribution of the Bryophyta in the Iser-Gebirge, with indications of the rarity or abundance of the various species in the different conditions presented by the mountains. Critical remarks upon some of the species are added.

Moss-flora of the Hohe Tauern.‡—F. Kern gives an enumeration (with localities and altitudes) of the moss-flora of the Hohe Tauern, consisting of 195 mosses and thirty hepatics. This rich moss district was first searched by Hornschuch and a few others a hundred years ago; but now that the German-Austrian Alpine Club have exploited the district and built many Alpine huts on the mountain-groups of the Grossglockner and Grossvenediger, the facilities for the bryologist are enormously increased. Secure of his night's lodging in the vicinity he is able to devote long hours of search to the gullies, rock-walls, waterfalls, etc., of this interesting range.

North American Hepaticæ.—A. W. Evans § continues his notes on New England Hepaticæ. In his sixth article he writes more especially of additions to the local floras of Maine, New Hampshire, and Connecticut. The species treated of are *Metzgeria pubescens*, *Marsupella robusta*, *Nardia crenuliformis*, *Lophozia attenuata*, *L. Baueriana*, *L. longiflora*, *Cephaloziella Sullivantii*, *Bazzania tricrenata*, *Leucolejeunea clypeata*, *L. unciloba*, *Frullania Selwyniana*, *Anthoceros Macounii*. Critical notes on these species are given, and some supplementary lists are added at the end of the paper.

C. C. Plitt ‖ publishes a preliminary list of hepatics found in the vicinity of Baltimore, consisting of thirty-eight species with annotations and distribution-tables.

A. Lorenz ¶ publishes a report on the hepatics of Franconia Mountains in New Hampshire, containing a list of seventy-seven species with annotations and distributional notes.

Hepaticæ of Samoa.**—F. Stephani gives an account of the Hepaticæ collected by K. Rechinger in Upolu and Savaii. He enumerates 79 species in all, namely, 73 for Upolu and 17 for Savaii. There are 21 new species, some of which are not described.

New Mosses from Mount Ruwenzori.††— G. Negri publishes diagnoses of twenty-two new mosses collected on Mount Ruwenzori, mostly at an altitude of 12,600 feet, during the expedition of the Duke of the Abruzzi. Their names are: *Sphagnum Aloysii-Sabaudiæ*,

* Mitteil. Bayrisch. Bot. Gesell., ii. (1908) pp. 103–9 (figs.).
† Lotos, Prag, 1907, n.s. i. pp. 145–52, 168–72, 186–90, 201–11.
‡ Fünfundachtzigster Jahr. Schles. Ges. Breslau, 2te Abt. b. zool. bot. sektion (1908) pp. 1–12.
§ Rhodora, x. (1908) pp. 185–93.
‖ Bryologist, xi. (1908) pp. 100–4.
¶ Tom. cit., pp. 112–14.
** Denkschr. Math. Nat. Akad. Wiss. Wien, lxxxi. (1907) pp 288–99.
†† Annali di Bot, vii. (1908) pp. 161–9.

S. ruwenzorense, *Dicranum petrophylum*, *Campylopus sericeus*, *C. Cagnii*, *Fissidens mobukensis*, *Leptodontium Gambaragaræ*, *Tortula Cavallii*, *Anœctangium Sellæ*, *A. fuscum*, *A. flexuosum*, *Amphidium Aloysii-Sabaudiæ*, *Zygodon Roccatii*, *Z. hirsutum*, *Macromitrium fragile*, *Brachymenium Cagnii*, *Pohlia Aloysii-Sabaudiæ*, *Bryum Sellæ*, *Breutelia auronitens*, *Catharinæa Cavallii*, *Polytrichum cupreum*, *Brachythecium Roccatii*.

Antarctic Mosses.*—J. Cardot publishes his complete monograph of the bryological flora of the Magellan region, South Georgia and the Antarctic region, it being one of the reports of the Swedish South Polar Expedition (1901–3). The subjects treated are the history of the subject from the time of Commerson (1767) up to our own days; the geography of the Magellan region; a list of 243 endemic species; the relationship and origin of this flora; distributional comparisons. The author infers that there has been a common origin for the Magellan region and New Zealand. He then gives systematic lists of all the mosses, and describes and figures several new ones, including among them two new genera *Verrucidens* and *Exodokidium*.

Life of Richard Spruce.†—A. R. Wallace has edited for publication the manuscript journals, letters, and notes of the late Richard Spruce (born 1817, died 1893), giving an account of the long travels on the Amazon and Andes (1849–64), during which Spruce reaped, *inter alia*, his rich harvest of mosses and hepatics, and began to make the brilliant observations of the latter group which many years later (1885) he gave to the public in his monumental work, Hepaticæ Amazonicæ et Andinæ. Wallace has compiled a biography of Spruce's life before his departure for South America and after his return.

Bornmüller, J.—**Flora der Elbursgebirge Nord-Persiens.** (Flora of Mount Elburz, in North Persia.)
[Contains a list of seven hepatics and sixty-four mosses.]
Bull. Herb. Boiss., viii. (1908) pp. 832–6, 915–17.

Kindberg, N. C.—**Bryogeografiska uppgifter.** (Notes on the geographical distribution of mosses.)
[Treats of Scandinavian species.] *Bot. Notiser Lund.* 1908, pp. 69–70.

Steinbrinck, C.—**Ueber den Kohäsionsmechanismus der Roll- und Faltblätter von Polytrichum commune und einigen Dünengräsern.** (On the cohesion theory in relation to the mechanism which controls the rolling up and folding of the leaves of *Polytrichum commune* and some grasses of the dunes.)
Ber. Deutsch. Bot. Gesell., xxvia. (1908) pp. 399–412.

Stephani, F.—**Species hepaticarum.**
[Continuation of monograph of *Mastigobryum*, containing descriptions of 178 species, several of which are new to science.]
Bull. Herb. Boiss., viii. (1908) pp. 837–66, 941–72.

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* Flore bryologique des terres Magellan. Stockholm (1908) 298 pp. (11 pls. and figs.). See also Rev. Bryol., xxxv. (1908) p. 142.
† Notes of a Botanist on the Amazon and Andes. Macmillan, 1908, 2 vols. (illustrated).

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

Aberrant Forms of Marine Algæ produced artificially.*—C. Techet publishes some observations upon some aberrant forms of marine algæ obtained by artificial cultivation. The experiments were not carried out systematically enough to allow general conclusions to be drawn. They show that the plants responded to stimuli in various ways; and the only general deduction is that in water of less salinity the plants assume a more quick-grown and less branched form than in more strongly saline solutions. The nutritive solution employed consisted of the following ingredients:—calcium nitrate 2 p.c.; potassium phosphate 0·2 p.c.: magnesium sulphate 0·2 p.c., with a trace of ferric chloride; sea-water 97·6 p.c. Every five months four or five drops of the above were added to the cultures and slowly and carefully stirred in with a glass rod. The jars used for the cultures were of glass and cylindrical, about 10 in. high and 8 in. diameter. The plants experimented with were *Halimeda Tuna*, *Udotea Desfontainii*, *Valonia macrophysa*, *Acetabularia mediterranea*. *Dasycladus clavæformis*, *Antithamnion Plumula*, *Callithamnion* sp., *Polysiphonia*, *Ectocarpus*. The results obtained are shown in a series of figures.

Light-perception in Algæ.†—R. H. Francé publishes a paper on the light-sensitive organs of algæ, in which he expresses his views as to the presence of an inner psychical faculty in plants; tells of his own experiments with *Euglena viridis* and *Polytoma uvella*; treats of the pigment-spot or eye-spot in these algæ; and constructs his theories as to the physiology of stimulation in plants.

Biology of Crater-lakes in South Italy.‡—A. Forti and A. Trotter publish an account of the flora and fauna of the two crater-lakes of Mt. Vulture, situated in southern Italy, between the province of Basilicata and the Principato Ulteriore. These Laghi di Monticchio are situated at an altitude of 2166 ft. above sea-level, and are about 100 ft. deep. The physical geography and the general aspects of the biology of the lakes are discussed by A. Trotter. The analysis of the microscopic material, and the preparation of the principal deductions therefrom, are the work of A. Forti. The latter detected forty-one algæ and twenty-five animals in the plankton gatherings, and has arranged these in a series of tables to illustrate his arguments. Further, he discusses each of the species in a separate paragraph by itself. In the deposit from the bottom of the lakes he found seventy-nine species of diatoms.

Algæ of Lampedusa and Linosa.§—S. Sommier publishes a modernised flora of the Pelagian Islands, Lampedusa, Linosa, and

* Nuov. Notar., xix. (1908) pp. 171–84 (figs.).
† Stuttgart: Kosmos, 1908, 80 pp. (1 pl. and figs.).
‡ Annali di Bot., vii. (1908) Suppl. 111 pp. (3 pls.).
§ Firenze: Stabilimento Pellas, 1908, 345 pp.

Lampione, and of Pantelleria, including a list of sixty algæ recorded for Lampedusa and thirty-seven for Linosa. Two of them are new to science.

German Fresh-water Algæ.*—W. Heering publishes the second part (Chlorophyceæ) of his account of the fresh-water algæ of Schleswig-Holstein and the neighbouring regions of Hamburg and Lubeck. F. Quelle† publishes an algal flora of Nordhausen. This district was originally worked up by F. T. Kützing, whose narrowed notion of species led him to establish them often on what are now held to be but developmental forms. Quelle has submitted Kützing's results to revision in the light of modern botany.

Fresh-water Algæ at Reval.‡—G. Schneider and others, in giving a complete biological account of the Obersee at Reval, devote a chapter to its vegetation, which includes a considerable number of fresh-water algæ—17 Schizophyceæ, 41 Chlorophyceæ, 29 Diatomaceæ—some of which (*Anabæna*, *Clathrocystis*, etc.) by the formation of "Wasserblüte" (algal scum) give trouble in connection with the Reval water-supply, derived from this lake. In another chapter is given a list of eighteen species which have been found living in the Reval water-supply. In Chapter vi. K. M. Levander treats of the biological conditions which affect the plankton, and indicates the date when each species was noticed: and further, he shows in a synoptical table the comparative degrees of frequency or rarity of each of the species found in the middle part of the lake during the summer months.

British Desmidiaceæ.§—W. and G. S. West publish the third volume of their monograph of the British Desmidiaceæ, including in it full descriptions with figures of 174 species of *Cosmarium*, with varieties, synonymy, literature, distribution, and critical notes. Keys to the species are provided, and an additional list of bibliography is appended.

Rhizoclonium and Cladophora.‖—F. Brand discusses the morphology and biology of the borderland species between the genera *Rhizoclonium* and *Cladophora*. Some of these species are stable, and some are transitory morphological phenomena. He describes in great detail *Cladophora fracta* var. *lacustris*, which is so variable as to have given rise to the theory that *Rhizogonium* merges ontogenetically into *Cladophora*. He then treats of the following in succession:—*Rhizoclonium profundum*; *R. sulfuratum* sp. n.; differential morphology of *Rhizoclonium* and *Cladophora*, including an amended diagnosis of the genus *Rhizoclonium*; and, in conclusion, the five species of *Cladophora* which are grouped in the section Affines, and more or less resemble permanently *Rhizoclonium*.

Morphology and Development of Pithophora.¶—A. Ernst publishes a contribution to the morphology and physiology of *Pithophora*, based

* Jahrb. Hamburg. wiss. Anstalt., xxv. (1907) beih. 3, 119 pp.
† Mitteil. Thüring. Bot. Ver., 1908, pp. 33-61.
‡ Archiv Biontolog. Berlin, ii. (1908) 192 pp.
§ London: Ray Society (1908) xv. and 274 pp. (pls. 65–95, partly coloured).
‖ Hedwigia, xlviii. (1908) pp. 45–73 (figs.).
¶ Ann. Jard. Bot. Buitenzorg, vii. (1908) pp. 18–55 (4 pls.).

upon a study of living material of *P. sumatrana* collected at Buitenzorg, in Java. He gives an emended description of the structure and development of the plant, of the spores and their germination. He treats of the ecology of the plant, and of the conditions of its life. In a third chapter he describes the experiments made to ascertain the conditions of reproduction of the plant in different liquids.

Rhodochytrium a Parasitic Alga.* — G. F. Atkinson describes a remarkable parasitic alga, *Rhodochytrium spilanthidis* Lagerh., found in North Carolina on the leaves and stem of the common Composite plant, *Ambrosia artemisiæfolia.* The zoosporangia were discovered after much search. The plant had been previously found by Lagerheim near Quito, Ecuador, in 1889, upon *Spilanthes*, another member of the Compositæ. The two localities are therefore separated by a tropical zone, and the question arises, whether this distribution is natural, or has been brought about by importation. The structure and development of the alga, its sporangia, and zoospores, are described. According to Lagerheim it is related most nearly to the *Phyllobium* of Klebs.

Green Coloration of Oysters caused by a Diatom.†—C. Sauvageau, in a rejoinder to D. Corazzi, summarises the arguments in favour of the contention that the green coloration of oysters at some stations is due to the blue diatom, *Navicula ostrearia*, citing especially the direct experiments which have been made with the diatom to demonstrate the rapidity with which the oyster acquires the green colour.

Adriatic Diatoms.‡—B. Schröder describes some new and rare diatoms found in plankton taken from the Adriatic. They are *Leptocylindricus adriaticus* sp. n.; *Striatella interrupta* (Ehrb.) Heiberg; *Biddulphia pellucida* Castracane, forma; *B. pelagica* sp. n. They were collected at various dates, and are preserved at the zoological station at Rovigno.

Fishing Spoiled by Algæ. — G. Besana announced in 1898 an invasion of *Ulothrix limnetica* Lemmerm. into Lake Como; and now he describes an extraordinary development of diatoms in the same lake in December 1907 and January 1908, so bad in fact as to render fishing impossible. The diatoms concerned are *Tabellaria fenestrata* Kuetz. and *Lysigonium varians* De Toni.

Italian Diatoms.—A. Forti ‖ describes and figures *Aulacodiscus miocenicus*, a new fossil species of diatom from Bergonzano, near Reggio d'Emilia, in Italy. He also describes¶ and figures *Pyxilla Squinaboli*, a new fossil species of diatom from Piedmont and from Reggio. D. G. Antonelli ** publishes a list of seventy diatoms found in the torrent and mineral waters of Aspio, near Ancona. A chemical analysis of the waters is given.

* Bot. Gaz., xlvi. (1908) pp. 299–301.
† Bordeaux: Destout, 1908, 23 pp.
‡ Ber. Deutsch. Bot. Gesell., xxvi*a* (1908) pp. 615–20 (figs.).
§ Rivist. Mens. di Pesca, x. (1908) n. 1, 2.
‖ Padova: Seminario, 1908, 2 pp. (pl.). See also Nuov. Notar., xx. (1909) (ined.).
¶ Atti Soc. Nat. Mat. Modena, ser. iv. x. (1908) 2 pp. (fig.).
** Atti Pontif. Accad. Romana d. Nuov. Lincei, lxi. (1908) pp. 79–93 (fig.).

Diatoms of Pas-de-Calais.—C. Cépède* furnishes a contribution to the study of the marine diatoms of Pas-de-Calais, not only giving an enumeration of the species with synonymy and habitats, but also treating the subject from the point of view of oceanography and pisciculture, owing to the well known fact that the diatoms serve as food to many marine creatures, and directly or indirectly to such important fishes as the sardine. He gives a list of twenty-two diatoms found in the intestine of the sardine. He also describes and figures a new plankton-net in which the closure is effected by means of a lever-stopper.†

Diatoms of Connecticut.‡—W. A. Terry publishes some lists of Connecticut diatoms representing material supplied by him to Tempère for inclusion in his "Diatomées du Monde entier," issued in the form of microscope-slides. The lists represent the floras of Ice Pond, New Britain; Fall Mountain, Bristol; Bunnel's Pond, Bristol; and the corresponding slides have already been issued by Tempère.

Mongolian Diatoms.§—E. Oestrup makes a contribution to a knowledge of the diatom-flora of the Kossogol Lake in North-west Mongolia, based upon thirteen plankton-samples and twenty-four bottom-samples obtained by C. H. Ostenfeld. The author enumerates 168 species, eight of which are new to science. In a distribution-table he compares this list with the diatom-floras of Lake Baikal, middle Asia, and Lake Balaton.

Danish Peridinieæ.‖—O. Paulsen gives an account of the Peridiniales of the Danish waters, prefacing the enumeration with an analytical scheme of the genera. Among the species are nine proposed as new.

Siamese Plankton.¶—E. Lemmermann gives an account of the phytoplankton collected at the mouth of the Menam, near Paknam, in Siam, by H. Schauinsland in 1906. The list contains 94 forms, comprising Bacillariaceæ (61), Peridinieæ (5), Silicoflagellatæ (2), Flagellatæ (12), Conjugatæ (3), Chlorophyceæ (9), Schizophyceæ (2). The author discusses the influence of the brackish water; makes critical remarks on some of the forms; draws up some general conclusions; and compares the plankton with that of the Yang-tze-kiang.

Studies on Ceratium.—C. A. Kofoid** describes the exuviation, autotomy and regeneration in *Ceratium*, from observations made at the Marine Biological station at San Diego in California.

The same author†† publishes notes on some obscure species of *Ceratium*.

Marine Biology.‡‡—J. Johnstone publishes a volume on "Conditions of Life in the Sea: a short account of Quantitative Marine Biological

* C.R. Ass. Franç. Avanc. Sci. Reims (Paris, 1908) pp. 536–68.
† Tom. cit., pp. 770–3.
‡ Rhodora, x. (1908) pp. 179–84.
§ Hedwigia, xlviii. (1908) pp. 74–100 (2 pls.).
‖ Meddel. fra Komm. f. Hafunders, i. No. 5 (Kobenhavn, 1907) 33 figs.
¶ Hedwigia, xlviii. (1908) pp. 126–39 (pl.).
** Univ. California Publications (Zool.) iv. (1908) pp. 345–86 (figs.).
†† Tom. cit., pp. 387–93.
‡‡ Cambridge University Press, 190

Research," wherein is given a summary of the main results of modern marine biological investigation. Part I. treats of the exploration of the sea, and contains a description of oceanographical apparatus, the constitution of the sea-bottom in northern waters, the living organisms—the plankton, benthos and nekton. Part II. is concerned with quantitative investigations, the estimation of the number of species, the distribution of the forms, their economic importance in relation to the fisheries. Part III. tells of the metabolism of the sea, the physiology of the organisms, the mystery of migration, the action of bacteria, the circulation of nitrogen. A bibliography is appended.

Regeneration in Myrionema.*—F. Tobler describes and figures the method of regeneration in *Myrionema*. *M. vulgare*, one of the commonest Ectocarpaceæ of the North Sea, forms remarkable brown spots on the upper parts of the stem of *Laminaria* where there is an absence of other algæ. In August 1907, in Trondhjem Fjord, in a strong sea-current, where only *Laminaria digitata* abounded at about 1–2 metres below low water-mark, the *Laminaria* stems were found to be free from all epiphytes except *M. vulgare*; and this showed signs of the action of the strong current. The tufts lacked the normal character of assimilators, hair-threads and (plurilocular) sporangia juxtaposed. The sporangia were absent, the hair-filaments rare. And the author describes in detail the anomalous appearance of the assimilators and the process of regeneration which was going on in some of them.

Biology of Polysiphonia fastigiata.†—G. Tobler-Wolff discusses the biology of *Polysiphonia fastigiata*, and states that in the North Sea it is only known to occur on *Ascophyllum nodosum*. She describes and figures its method of penetrating the cortex of the latter plant, and endeavours to explain how it is that it does not occur on *Fucus* also. [According to British authors it is epiphytic upon both *Ascophyllum* and *Fucus*, but chiefly upon the former.]

Developmental History of the Delesseriaceæ.‡—W. Nienburg gives a detailed account of the germination and development of the Delesseriaceæ, paying special attention to the subsequent history of the segments successively cut off from the apical cell in *Nitophyllum*, *Delesseria*, etc., and illustrating the same by figures in the text.

Notes on Lithothamnia.§—M. Foslie publishes some remarks on *Lithothamnion murmanicum* Elenkin, and the question of its affinity with *L. nodulosum* and *L. vardöense* Fosl. He thinks *L. murmanicum* to be probably identical with *L. breviaxe* Fosl., and adds critical notes on various species, giving photographs of *L. breviaxe* and *L. vardöense* and a figure of *L. tophiforme* Ung.

The same author ‖ treats of species in the following genera: *Lithothamnion* (9), *Lithophyllum* (5), *Mastophora* (2), *Phymatolithon* (1), *Clathromorphum* (1), and *Melobesia* (1), giving descriptions and critical notes.

* Ber. Deutsch. Bot. Gesell., xxvi*a* (1908) pp. 476–9 (figs.).
† Beih. Bot. Centralbl., xxiv. 2te Abt. (1908) pp. 112–16 (figs.).
‡ Bot. Zeit., lxvi. (1908) pp. 183–209 (1 pl. and 47 figs.).
§ K. Norske Vidensk. Selsk. Skrift, 1908, No. 2, 8 pp. (2 pls. and fig.).
‖ Tom. cit., No. 7, 20 pp.

Corallinaceæ of the Pacific.*—M. Foslie gives an account of the Corallinaceæ collected by K. Rechinger during an expedition in 1905 to the Samoa Isles, New Guinea Archipelago and Solomon Isles, including two new species from the Sandwich Isles, one (*Archaeo-lithothamnion zonatosporum*) from Los Angeles in California, and seven from Samoa.

Studies in Marine Algæ.†—A. Mazza continues his studies of oceanic algology and describes and discusses some species of the following genera: *Grinnellia*, *Caloglossa*, *Sarcomenia*, *Sonderella*, *Claudea*, *Vanvoorstia*, *Delisea*, *Bonnemaisonia*, *Asparagopsis*.

European Algæ.‡—W. Migula continues the cryptogamic part of Thomé's Flora von Deutschland, Oesterreich und der Schweiz. Parts 57–65 treat of the Phæophyceæ and Characeæ, and complete the account of the algæ. The descriptions are in German. Keys to the genera and species are supplied.

Antarctic Algæ.§—T. Reinbold gives an account of the marine algæ of the German South Polar Expedition (1901–3). He sketches the work previously published on collections made in various parts of the antarctic region, shows that our knowledge is still limited to a small part only of that region, and that there is a well-marked sub-antarctic circumpolar algal flora (characterised by *Macrocystis* and *Durvillæa*) distinct from the proper antarctic flora (characterised by *Desmarestia*, *Lessonia* and *Scytothalia*). The stations from which specimens were obtained were as follows: Kerguelen, Crozet Island, New Amsterdam Island, Cape of Good Hope, St. Vincent (Cape Verde).

Marine Algæ of San Thome.||—P. Hariot gives a list of thirty-eight marine algæ from the Portuguese island of San Thome, off the coast of West Africa, gathered by Quintas, Moller, Praença, and Gravier. The list contains twenty-one species which are additional to the flora of the island, and raise its total to fifty-seven species or varieties. *Gracilaria Henriquesiana* is a new species, and is figured.

Red Sea Algæ.¶—R. J. Harvey-Gibson gives an enumeration of the algæ collected in the Red Sea by C. Crossland, near Suakim, during an investigation of the biology of the Sudanese marine fauna during 1904–5. Thirty-five species are recorded, being almost equally divided between green, brown, and red algæ.

BRANDT, F.—**Ueber das Chromatophor und die systematische Stellung der Blutalge (Porphyridium cruentum).** (Concerning the chromatophore of *Porphyridium cruentum*, and the systematic position of the plant.) *Ber. Deutsch. Bot. Gesell.*, xxvia. (1908) pp. 413–19 (fig.).

,, ,, **Weitere Bemerkungen über Porphyridium cruentum (Ag.) Naeg.** (Further observations upon *Porphyridium cruentum*; its morphology and biology.) *Tom. cit.*, pp. 540–6.

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* Denkschr. Math. Nat. Akad. Wiss. Wien, lxxx. (1907) pp. 209–10.
† Nuov. Notar., xix. (1908) pp. 153–70.
‡ Gera: Zezschwitz, 1908, vi. pp. 225–384 (65 pls.).
§ Deutsch Sudpolar. Exped., viii. (1908) pp. 179–202.
|| Journ. de Bot., xxi. (1908) pp. 161–4 (fig.).
¶ Journ. Linn. Soc. (Zool.) xxxi. (1908) pp. 76–80.

Clark, H. W.—**The Holophytic Plankton of Lakes Atitlan and Amititlan, Guatemala.** [Includes three new species—*Clathrocystis robusta*, *Staurastrum Evermanni*, *Conferva gyrans*.] *Proc. Biol. Soc. Washington*, xxi. (1908) pp. 91–105.

Drabble, E. & H.—**Hydrodictyon reticulatum Lagerh.**
[Abundant, in August 1908, in the River Idle, North Nottinghamshire.] *Journ. of Bot.*, xlvi. (1908) p. 365.

Edwards, A. M.—**Bacillaria: what are they?**
[A remarkable short essay upon Diatoms.] *Mém. Soc. Sci. Nat. Cherbourg*, xxxvi. (1907) pp. 429–32.

Hallas, E.—**Om Œdogonium inclusum Hirn.**
Bot. Tidsskr., xxviii. (1907) pp. 211–13 (figs.).

Hattori, H.—**Vorlaufige Mitteilung über das Phytoplankton vom Suwa-see.** (Preliminary account of the phytoplankton of the Suwa lake.) *Tokyo Bot. Mag.*, xxii. (1908) pp. 121–6 (figs.).

Larter, C. E.—**North Devon Cryptogams: Algæ.**
[Records *Ceramium circinatum* Ag., as an addition to the local flora; and adds notes on the occurrence of the recently described *Callymenia Larteriæ* Holmes.] *Journ. of Bot.*, xlvi. (1908) p. 393.

Svedelius, N.—**Frans Reinhold Kjellman.**
[Obituary notice of Prof. Kjellman of Upsala, algologist, with portrait and list of seventy-one published works. Born, 1846; died, 1907.] *K. Svensk. Vet. Akad. Aorsbok*, 1908, pp. 279–300 (pl.).
See also Obituary Notice in *Proc. Linn. Soc.*, 1907–8, pp. 50–3.

Fungi.

(By A. Lorrain Smith, F.L.S.)

Swiss Mucorini.*—Alf. Lendner has edited the section of Swiss Cryptogamic Flora dealing with the Mucorini. He gives great attention to the conditions and circumstances of habitat and development of these plants, and recounts how he was able to obtain cultivations of a large number of the species dealt with. He compares genera and species one with another in their vegetative and reproductive organs, citing the work of others as well as his own observations on morphology and histology. The second part of the book is devoted to classification, the Mucorini being divided into families: Mucoraceæ, Thamnidiaceæ, Pilobolaceæ, Chætocladiaceæ, and Cephalidaceæ. The two latter include the conidia-bearing genera, such as *Chætocladium*, *Piptocephalis*, etc. A copious bibliography and index complete the volume. The genera and species are illustrated by figures in the text, and three plates give enlarged drawings of the zygospores of *Sporodinia grandis*, to illustrate the details of nuclear and protoplasmic structure. A number of new species are described in the course of the work.

Genus Pythium and some Chytridiaceæ.†—This memoir by Butler includes a monograph of the genus *Pythium*, which he divides into two subgenera:—1. *Aphragmium*, in which the species produce neither conidia nor sporangia, the zoospores arising in undifferentiated cells of the mycelium; they are all water forms. 2. *Sphærosporangium*, which in-

* Flore Cryptogamique Suisse. Berne: K. J. Wyss, 1908, iii. fasc. 1, 180 pp. (3 pls. and 59 figs.).

† Mem. Dep. Agric. India, February 1907. See also Zeitschr. Pflanzenkr. xviii. (1908) pp. 243–4.

cludes the land forms, and in which the zoospores are developed in sporangia, or, if conditions are unfavourable for sporangia, conidia are developed; in some species only the latter are formed. All the species can be cultivated as saprophytes; the most destructive parasite of the genus is *P. de Baryanum*, which attacks seedlings. The author has also described a number of new species of Chytridiaceæ.

Witches' Brooms on Prunus padus.* — C. v. Tubeuf discovered near Munich a witches' broom on the bird-cherry. In the immediate neighbourhood there were three old cherry trees with large "brooms" caused by *Taphrina Cerasi*, and Tubeuf is of opinion that infection spread from these trees to the bird-cherry. It is very unusual to find "brooms" on the latter tree, for this reason, that the two kinds of cherry do not form their leaves at the same time, and those of the bird-cherry are very seldom in the stage of development at a time when inoculation is possible from the spores of *Taphrina Cerasi*.

Monograph of the Laboulbeniaceæ.†—R. Thaxter presents this memoir as a contribution to the subject, which he has not yet exhausted, as much material still remains for examination. Nearly 350 forms are illustrated, increasing to about 500 the total number of species and varieties thus far described, which are included in more than 50 genera. They all find their habitat on insects, but their growth is not associated with any appreciable injury to the host. A general survey is given of the various forms, with comparative descriptions of the vegetative and reproductive organs, and a key to the genera is provided. Thaxter states that although these plants resemble the Florideæ in some respects more clearly than they do any other plants, they are more surely Ascomycetes than many forms included in that group, and he sees no sufficient reason why they should not be placed in the Pyrenomycetes as a group co-ordinate with the Perisporiales, Hypocreales, etc. The bulk of the work is occupied by diagnoses of new genera and species, and by plates to illustrate the new forms.

Culture of Truffles.‡—Zacharewicz discusses the conditions that affect the growth of these underground fungi in Vaucluse in connection with different kinds of oak. For purposes of propagation "glands" must be chosen from a fertile tree. The growth of cereals, leguminous plants, and especially of vines, help to prepare the soil for the truffles. The author recommends cutting the roots of the trees so as to encourage horizontal growth. Certain chemical manures, lime, and methodical watering are recommended.

Hyphomycetes.§—G. Lindau includes a large number of genera in the present fascicle, including *Tilachlidium*, *Isaria*, *Stilbum*, *Graphium*, etc; in the latter he has figured some of the more curious forms. *Coremium* is retained as a genus with several species.

* Naturw. Zeitschr. Land. Forstw., vi. (1908) pp. 372–4. See also Bot. Centralbl. cviii. (1908) p. 530.

† Mem. Amer. Acad. Arts Sci., xiii. No. 6 (1908) pp. 219–469 (44 pls.).

‡ Res. Vitic., xxix. (1908) pp. 300–3 and 322–5. See also Bot. Centralbl., cviii. (1908) p. 553.

§ Rabenhorst's Kryptogamen Flora, i. 9te Abt, lief. 110 (Leipzig, 1908) pp. 305–68.

Parasitic Fungus on Rubus dumetorum.*—A fungus causing deformation of the buds and flowers of this plant was detected by H. Diedicke, and determined by H. and P. Sydow to be a member of the Hyphomycetes, *Pœpalopsis deformans*. Further observation and examination have led to the discovery of pycnidia, and the fungus is now placed among the Sphæropsidiæ as *Hapalosphæria deformans* g. et sp. n. The pycnidia are clear brown in colour with a thickish wall that soon falls away and with globose hyaline spores. The mycelium had attacked the flowers and penetrated the anthers.

Studies in the Genus Gymnosporangium.† — Along with the diagnoses of new species, Frank D. Kern gives a key for the determination of the teleutospore stage of the fungus. The study of the relationship between host and parasite is rendered more complicated owing to the fact that a number of different species are now known to exist on the same host. The teleutospore stage in almost every species grows on only one host—one of the Juniperaceæ, represented by four genera, *Sabina*, *Juniperus*, *Chemæcyparis*, and *Libocedrus*. All the species are heterœcious, and in none is there any uredo-form. In most of them the development is accompanied by distortion of the leaves or branches. Three new species are described from Alabama, Wisconsin, and Texas.

Smuts of Sorghum.‡—The grain and kernel smut *Sphærotheca Sorghi*, and the head-smuts *S. reiliana* have been described by E. M. Freeman and B. J. C. Umberger. *S. Sorghi* is the most widely distributed, occurring almost universally wherever *Sorghum* is grown. Directions are given for dealing with these pests ; hot-water treatment of the seed being especially recommended as being both effective and inexpensive.

Higher Fungi.—M. E. Hard § has published a volume intended as a guide to distinguish between poisonous and edible forms in the United States. The author discusses the general classification with the structure and life-history of fungi. Attention is given to individual species, and a chapter follows on cooking and on cultivation of mushrooms. Good photographs of the species accompany the text.

F. Kauffman ‖ describes the methods of examining and preparing specimens of the Higher Fungi, and then gives a list of the species observed by him in West Prussia ; the form, locality, etc., of each species is given ; the whole forming a valuable contribution to the knowledge of German fungi. Only Hymenomycetes are included in the list and the larger fleshy Discomycetes, especially the Helvellaceæ.

The same author ¶ gives a further list of Boletineæ from the same territory. He divides this family into five genera : *Suillus*, *Strobilo-*

* Ann. Mycol., vi. (1908) pp. 301–5 (12 figs.).

† Bull. Torrey Bot. Club, xxxv. (1908) pp. 499–511.

‡ Bur. Plant Ind. U.S. Dept. Agric., Circ. No. 8 (1908). See also Bot. Centralbl., cviii. (1908) p. 577.

§ Ohio Library Co., 1908, 609 pp. (504 figs.). See also Bot. Centralbl., cviii. (1908) p. 526.

‖ Städt. Oberrealschule Elbing Jahresb., 1906–7. See also Bot. Centralbl. cviii. (1908) pp. 528–9.

¶ Ber. Westpr. Bot. Zool. Ver. Danzig, 1907. See also Bot. Centralbl., cviii. (1908) p. 529.

myces, *Tylopilus*, *Cricunopus* and *Boletus*. The latter genus he divides according to the colour and form of stalk, pores and pore openings. Kauffman has found thirty-four species of *Boletus* and a number of varieties in West Prussia.

Mushrooms propagated from Spores.* — An edible mushroom, *Agaricus* (*Psalliota*) *elvensis*, was collected by M. C. Cooke and H. T. Wharton in 1881, and broken parts of the plants were thrown out by them into their respective gardens. Cooke writes an account of the growth of this fungus a few years later on the place where he had thrown the specimens, under the drip of a pear tree, and states that they grow there year after year. Wharton has recently submitted specimens to him grown in his garden under the same conditions. Cooke considers that in both cases these mushrooms have been developed from fragments, if not from spores. *A. elvensis* is a large and finely flavoured species, and worthy of the attention of the mushroom cultivator.

Researches in Mycology.†—O. Brefeld has issued a volume dealing with the culture of fungi and with results obtained by him. He describes the different methods of culture he has found useful for different types of fungi, and then he restates his views as to the evolution and relationships of the different groups. He derives the ascus from the sporangium, the basidium from the conidial form; he does not admit the existence of sexuality in the higher fungi, and states that Stahl's work on *Collema* remains unconfirmed.

Atlas of Edible and Poisonous Fungi.‡—A small Italian guide to fungi has been published by Giovanni Negri. It contains sixty-three coloured plates, representing all the common edible or poisonous forms, and is intended to educate the general public in the selection or rejection of fungi for food. In the preface he tells of the large numbers of people that are poisoned every year by eating the wrong kinds; he insists that exact knowledge is necessary. O. Mattirolo has written a preface explaining the aims of the book.

Classification of the Basidiomycetes.§—Much work has been done on this subject in recent years, and Léon Dufour has published a sketch of the varying methods of classification of this group of plants adopted by different authors, Fries, Brefeld, Juel, and Patouillard. The two great groups of Protobasidiomycetes and Autobasidiomycetes recognised by Brefeld form the basis of the modern ideas on the subject, though further cytological work opens up new views of the relationships of the many different forms. Dufour considers that systematists understand now more fully the characters that are of importance, and they recognise the lines on which any future scheme must be arranged.

Mycological Notes: Nos. 30 and 31.‖—The first of these by C. G. Lloyd, deals with certain genera and species of Phalloids, and

* Journ. Hort. Soc., xxxiv. (1908) pp. 218–21 (1 fig.).
† Untersuch. aus dem Gesamt. der Mykologie, xiv. Münster (Westf.), 1908 256 pp. See also Bot. Centralbl., cviii. (1908) pp. 416–18.
‡ Torino: Corso Raffaello, 1908, xxxv. and 106 pp. (63 col. pls.).
§ Rev. Gén. Bot., xx. (1908) pp. 417–28.
‖ Cincinnati O., Feb. and Aug., 1908, pp. 381–411 (33 pls.).

photographs and descriptions are given of a number of little known forms such as *Clathrus Treubii* and *Simblum gracile*, both from Java. Lloyd publishes a request for undeveloped eggs of *Lysurus borealis*. He gives an account of the Gastromycetes of Schweinitz's Herbarium, correcting the determinations of specimens in several cases. In No. 30, the Phalloids of Japan are dealt with, including the genera *Phallus*, *Mutinus*, *Lysurus*, and *Laternea*. Additional notes on *Lysurus Gardnerii* and *Anthurus aseræformis* are given. Lloyd prints photographs of the homes of A. P. Morgan and of Linnæus, with a portrait of the former.

Handbook of Fungi.*—There has recently been issued from the British Museum a new edition of the Guide to Sowerby's Models of Fungi. The book claims to be only a description of these, some 200 in number, but it forms a good introduction to the field-study of the larger fungi, as the models represent largely the more familiar and conspicuous forms. Special attention is paid throughout to the cooking properties, the main object of the models being to enable people to distinguish between edible and poisonous species. A glossary of technical terms is added.

Book of Garden Pests.†—R. Hooper Pearson has issued a useful handbook of fungoid and insect pests that infest cultivated plants. The plants are divided into sections of miscellaneous garden plants, fruit trees, and vegetables, and arranged alphabetically. Under each plant are recorded the fungi and insects that cause diseases, with short accounts of each and the most practical methods of dealing with them. A full account is given of insecticides and fungicides. The book is well illustrated by drawings and photographs, and forms one of a series of Handbooks of Practical Gardening.

Plant Diseases.‡—As many Baldwin apples are marred by the presence of fruit spots, Charles Brooks has made a study of the subject, and finds that the spotting is due to a fungus, *Cylindrosporium pomi* sp. n. The fruits are attacked in July or early in August, probably from spores developed on apples that may have lain on the ground all winter. If the apples are infected at an early stage the fungus is cut off from the apples by a layer of cork cells, forming a barrier to its further development. If the attack supervenes later, when the apples are more mature, the fungus develops rapidly and causes the browning and drying of the host tissue. Spraying with Bordeaux late in June or early in July is recommended.

Ugo Brizi § reports on samples of grain sent for examination to the Agricultural School of Milan. He had noted the low percentage of germination and the poor growth that resulted from sowing the seed. The grains were, to outward appearance, healthy, but microscopic examination showed the presence of fungal mycelium which had probably gained entrance at an early stage of seed development. Cultures determined the fungus to be *Aspergillus fumigatus*. Brizi

* British Museum (Nat. Hist.): Worthington G. Smith, 1908, 85 pp. (91 figs.)
† London: John Lane, 1908, 216 pp.
‡ Bull. Torrey Bot. Club, xxxv. (1908) pp. 423–56 (7 pls.).
§ Reale Ist. Lomb., xli. (1908) pp. 668–71.

found that the appearance of the seeds corresponded with the pellagra seeds of maize; he tested their toxic properties on eight mice, four of which died in the space of three days. He compares the fungus with the mycelium observed in the seed of darnel grass.

C. J. J. van Hall and A. W. Drest * describe the disease of cacao caused by *Colletotrichum luxificum* sp. n. The spores of the fungus alight on the buds and penetrate the young tissue, inducing abnormal growth of the branch, on which are fully developed the fungus pustules. If a fruit bud is infested, the mycelium lodges in the ovary and the fruit suffers from hypertrophy. Many of the apple trees have been killed by the fungus and the yield of fruit seriously affected. The authors give in detail their various culture experiments, and recommend methods of dealing with the disease.

Ch. Bernard † reports on the parasitic fungi of several cultivated plants. On *Thea assamica*, *Pestalozzia palmarum* works considerable harm by destroying the leaves. Cutting off affected leaves and preventive spraying with Bordeaux mixture are both advisable. *Hypochnus Theæ* forms felt-like growths on twigs and leaves. Although entirely superficial, it weakens the tree and renders it more liable to injury from other parasites. *Guignardia Theæ* forms spots on the leaves similar to those caused by the *Pestalozzia*, the methods recommended for dealing with these fungi are all the same, destroying the affected parts and spraying with Bordeaux mixture as a preventive.

On *Kicksia elastica* the most troublesome fungus was a species of *Capnodium*, which lived on the honey-dew of *Aphides*, and covered the leaves with a felt of dark-coloured mycelium. In this case the insect had to be destroyed, and the most effective agent was a petroleum emulsion; washing with water also proved useful.

Paul Hariot ‡ writes on the *Oidium* of oak trees which appeared in France towards the end of 1907, and which has spread rapidly, doing extensive damage to young trees. He discusses the various theories as to the importation of the disease and explanations of the sudden outbreak; the fungus had been noted in previous years, but only to a very limited extent.

Thierman § describes an epidemic of *Sclerotinia baccarum* on the bilberry in Tharandt. It was accompanied by a wide-spread attack of caterpillars on the same plants, and the writer considers that the caterpillars helped to disseminate the spores as they crawled over the leaves. The berry harvest was completely destroyed.

A number of diseases have been reported ‖ from Nebraska by various workers. W. V. Pool discusses several diseases of tomatoes. *Alternaria fasciculata* causes black rot at the blossom-end of the fruit; inoculation experiments proved that only ripe fruits took the disease. A black rot of apples was found by L. B. Walker to be caused by a *Sphæropsis* which

* Rev. Trav. Bot. Néerl., iv. (1908) pp. 243–319 (17 pls.).

† Bull. Dép. Agric. Indes Néerl., vi. (1907) 55 pp. (4 pls.). See also Zeitschr. Pflanzenkr., xviii. (1908) pp. 240–3.

‡ Comptes Rendus, cxlvii. (1908) pp. 816–18.

§ Ann. Mycol., vi. (1908) pp. 352–3 (1 fig.).

‖ Ann. Rep. Agric. Exp. Stat. Univ. Nebraska, Jan. 1908. See also Bot. Gaz. xlvi. (1908) pp. 391–2.

differs from the ordinary form in the size of the pycnidia and spores. F. D. Heald describes various types of barley-smuts, with notes on experiments as to the best methods of treatment; the percentage of germination was lessened by all the substances used except hot water. F. A. Wolf found *Pestalozzia uvicola* on ripe grapes; the spores were borne in pycnidia and not in pustules, as in other members of the genus. F. D. Heald and W. V. Pool examined the mould of maple syrup. It is *Torula saccharina*, and grows in pure cultures on media of varying composition; concentration of the sugar solution in which the fungus was growing did not affect the size of spores or hyphæ.

F. W. Neger * discusses the mortality among pines in Saxony and elsewhere. The trees show first symptoms of declining by losing their needles and smaller branches. The causes, he considers, are the presence of smoke to a small extent, occasionally the growth of the fungus *Corticium amorphum*, but chiefly the disease is due to *Armillaria mellea*, which attacks and kills the roots.

A. W. Borthwick † reports a disease on *Picea pungens*; an Ascomycetous fungus resembling *Cucurbitaria* attacks the buds and induces black conical swellings: the bud dies off or produces a twisted and cankered shoot. Another Ascomycete was signalled on the leaves of *Abies pectinata*; the leaves turn brown, and considerable damage is done to the trees.

G. H. Pethybridge and E. H. Bowers ‡ have made a special study of the dry-rot of the potato tuber. This disease had appeared on a farm in Kilkenny, and caused considerable loss in the field and among the stored potatoes. Observation and experiments left no doubt that the disease was due to *Fusarium Solani*, of which the parasitic nature was fully demonstrated. Advice is given as to measures for checking the spread of the disease.

H. Grisson § has examined the canker of rose trees, formerly thought to be caused by frost, and finds that it is due to the presence of a fungus, *Coniothyrium Fuckelii*, the pycnidial form of *Leptosphæria Coniothyrium*, which is frequently found on dead twigs of *Rubus*. The development of the disease is described. The author recommends cutting off the cankered twigs and the coating of the wound with wood-tar or grafting-wax.

Grisson also reports a disease of blackberry of a similar nature. The canker in this case is caused by a species of *Coniothyrium* not yet described, which he names *C. tumæfaciens*. It causes excrescences the size of a pea or a walnut on the shoots of the blackberry.

From the Department of Agriculture and Technical Instruction for Ireland ‖ there have been issued two popular papers on black scab in potatoes and mildew on gooseberries. The first-mentioned is spreading widely over England and Scotland, and doing very great damage; it has not yet appeared in Ireland, so the paper is written as a

* Tharandt. Forstl. Jahrb., lviii. (1908) pp. 201–25 (3 pls. and 2 figs.). See also Bot. Centralbl., cviii (1908) pp. 495–6.

† Trans. Bot. Soc. Edin., xxiii. (1907) pp. 232–3.

‡ Econ. Proc. Roy. Dublin Soc. i. (1908) pp. 547–58 (1 pl.).

§ Journ. Hort. Soc., xxxiv. (1908) pp. 222–30 (4 figs.)

‖ Dept. Agric. and Tech. Inst. Ireland, Leaflets No. 76 and 91 (1908).

warning to growers to avoid buying diseased seed. It is otherwise with the American gooseberry mildew which made its appearance first of all in Ireland. The appearance of the disease is described, and prompt treatment recommended in order to check the disease or to stamp it out.

Schaffnit-Bromberg * gives a summary of plant-diseases noted in Posen and West Prussia during 1907. Most damage was done to cereals by various species of rust and smuts. The survival of the uredospores of *Puccinia dispersa* was completely proved. Late sowing of seed is recommended. Notes are added as to the efficiency of the various methods of destroying the fungus. Instructions are also given as to the spraying of fruit trees, etc., and as to the choice of immune potatoes for seed.

O. Knischewsky † has given a review of the diseases of tropical economic plants in recent years. On cocoa *Phytophthora* and *Nectria Theobromæ* have worked great damage. Cutting away diseased parts of the host and thinner planting of the trees are recommended. *Hymenochæte noxia* destroys a number of useful trees in Samoa, Java, and New Guinea. Cocoa, breadfruits, *Erythrina Cassia*, and others, suffer from its depredations. It attacks the base of the stem and gradually encircles the tree. *Pestalozzia palmarum* and *Læstadia Theæ* are recorded on the tea plant, *Phytophthora* on tobacco, and *Septoglœum Manihotis* on *Manihot*. The latter tree is also attacked by an undetermined fungus that destroys the roots and base of the stem.

Aranzadi, Telesforo de—**Hongos observados en Cataluna el otono de 1907.** (Fungi noted in Cataluna in the autumn of 1907.)
[A list of Basidiomycetes.] *Bol. Soc. Hist. Nat.*, viii. (1908) pp. 351-6.

Dietel, Paul—**Uredinaceæ paraensis.** (Uredineæ from South America, several of them new species.) *Bol. Mus. Goeld.*, v., pp. 262-7 (1908).

Hansen, Emil Chr.—**Recherches sur la physologie et la morphologie des ferments alcooliques.** (Research on the physiology and morphology of alcoholic ferments.) *C.R. Lab. Carlsb.*, vii. (1908) pp. 179-217 (10 figs.).

Höhnel, F. von—**Mykologisches xviii.-xxi.**
[Notes on species of *Leptosphæria*, *Cladosterigma Fusisporum*, *Sphæria cooperta* and *Sporidesmium hypodermium*; the latter is a species of *Pestalozzia*.] *Oesterr. Bot. Zeitschr.*, lvii. (1907) pp. 321-4.
See also *Bot. Centralbl.*, cviii. (1908) pp. 494-5.

Piedallu, André—**Sur une levure qui agit sur les corps gras, son rôle dans le tannage à l'huile.**
[A yeast which acts on fatty bodies, and its role in the process of tanning by oil.] *C.R. Soc. Biol.*, lxv. (1908) pp. 114-16.

Quilter, H.—**A Contribution to the Micro-Fungi of Leicestershire.**
[Ninety-four species are included in the list.]
Leicester Lit. Phil. Soc., xii. (1908) pp. 70-4.

Rehm, H.—**Ascomycetes novi.**
[Discomycetes and Pyrenomycetes from America, Europe, India and Australia. The new genera described are: *Pleiopatella* near to *Tryblidium* and *Mollisiopsis* allied to *Mollisia*, both from North America.]
Ann. Mycol., vi. (1908) pp. 313-25.

Rota-Rossi, G.—**Terza contribuzione alla micologia della Provincia di Bergamo.**
[Third contribution to the mycology of Bergamo.]
Atti Ist. Bot. Univ. Pavia, ser. 2, xiii. (1907) pp. 195-212.
See also *Bot. Centralbl.*, cviii. (1908) p. 418.

* Zeitschr. Pflanzenkr., xviii. (1908) pp. 272-4. † Tom. cit., pp. 276-85.

Rouppert, Casimir—**Discomycetum species novæ tres.**
[Three new species: *Sphærosoma Janczewskianum*, *Lachnea Chelchowskiana* and *Cubonia Niepolomicensis*, are described.]
Bull. Int. Acad. Sci. Cracovie, 1908, pp. 651–2.

Schionning, H.—**On Torula in English Beer Manufacture.**
C.R. Lab. Carlsb., vii. (1908) pp. 138–78.

Stranak, Fr.—**Studie o temnostni flore jeskyn sloupskych.** (Study of the mycological flora of caverns.)
[Fungi from the caverns in Moravia.]
S.B. Ges. Wiss. Math. Nat. Cl., 1907, Vestnik, part xii., 41 pp. (text figs.).
See also *Bull. Soc. Mycol. France*, xxiii. (1908) pp. 253–4.

Theissen, F.—**Novitates Rio-grandenses.**
[New species of *Xylaria*, *Hypoxylon*, *Stilbohypoxylon*, *Penzigia*, *Ustulina*, *Nummularia* and *Rosellinia*, from Rio Grande do Sul (Brazil).]
Ann. Mycol., vi. (1908) pp. 341–52 (4 figs.).

Tiraboschi, Carlo—**Ulteriori osservazioni sulle muffe del granturco guesto.**
[Species of *Aspergillus*, *Cladosporium*, *Hormodendron* and *Diplodia* are discussed.] *Ann. Bot.*, vii. (1908) pp. 1–31 (1 pl.).

Zahlbruckner, A.—**Schedæ ad "Kryptogamas exsiccatas" editæ a Museo Palatino Vindobonensi.** (Fungi, Cen. xv.–xvi.)
[The species are listed and accompanied by full bibliography.]
Ann. k.k. Nat. Hofmuseums, Wien, 1907, pp. 81–102.

Lichens.

(By A. Lorrain Smith, F.L.S.)

European Lichens.*—H. Olivier publishes the first fascicles of this comprehensive work. There is a very short introduction, a more full and general discussion being promised at a later stage. Olivier begins with the old classification of heteromerous lichens and gives the first place among these to the fruticulose, then the foliaceous. Of these he records for Europe 310 species. The largest number has been found in France, 243 in all. In the British Isles there have been found 206, so that 104 are wanting to complete the list. A key is published of the genera, and similar keys to the species precede each genus. No detailed diagnosis is given beyond that contained in the keys, but a certain amount of bibliography accompanies the name, and the habitat and localities are added.

American Lichens.†—G. Lindau has determined a number of lichens from the Andes of Peru and from Colombia, collected by Weberbauer and Pehlke. The collection, although small, shows the different lichen vegetation in these two territories. Lindau describes four new species.

Baroni, E.—**Seconda contribuzione alla Lichenologia della Toscana.** (A list of 118 species recorded from Tuscany.) *Ann. Mycol.*, vi. (1908) pp. 331–40.

Galloe, D.—**Danske Likeners Økologi.** (Œcological study of Danish Lichens.)
Bot. Tidsskr., xxviii. (1908) pp. 285–372 (14 pls.).

Hue, A.—**Heppiearum ultimæ e familiæ Collemacearum tribubus nonnullas species morphologice et anatomice elaboravit.** (Some species of *Heppia*, the concluding family of Collemaceæ, described anatomically and morphologically.)
[A number of new species described and a key of the genus given.]
Mém. Soc. Nat. Sci. Nat. Math. Cherb., xxxvi. (1906–7) pp. 1–44.

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* Mém. Soc. Sci. Nat. Cherb., xxxvi. (1906–7) pp. 77–274.

† Eng. Bot. Jahrb., xlii. (1908) pp. 49–60. See also Bot. Centralbl. cviii. (1908) pp. 553–4.

Merril, G. K.—**Lichen Notes, No. 7.** (A list of lichens from the Upper Yukon collected by J. Macoun.) *Bryologist*, xi. (1908) pp. 105–11.

Wilson, A., & J. A. Wheldon—**Inverness-shire Cryptogams.** (A large number of lichens are included in this list.) *Journ. Bot.*, xlvi. (1908) pp. 353–6.

Zahlbruckner, A.—**Schedæ ad 'Kryptogamas exsiccatas' editæ a Museo Palatino Vindobonensi. Lichenes (Decades 35 38).**
[Diagnoses are given of some of the species and bibliography of all those listed.]
Ann. k.k. Nat. Hofmuseums, Wien, 1907, pp. 107–17.

,, ,, **Lichenes Amazonici.** (First contribution to the Lichen flora of Brazil.) *Bol. Mus. Goeld.*, v. pp. 258–61 (1908).

Schizophyta.

Schizomycetes.

Elastico-tropic Appearances in the Growth of Bacillus anthracis and Allied Bacilli in Serum Medium.*—P. Eisenberg considers that the peculiar feathery growth of *B. anthracis* and other organisms on inspissated serum must be regarded as a mean of the elastic-pulling force, influenced by two factors—the force of gravity and the drying of the medium towards the edges; the pulling forces being directed respectively from above vertically and from without horizontally, giving the branches a resultant diagonal direction. The firmness of the serum and the strong aerophilia of the organism limit the branched growth almost entirely to the surface, thus contrasting with the growth of *B. Zopfii* in the substance of gelatin.

Tetragenus tardissimus.†—G. Altona has isolated a new variety of micrococcus from the blood and liver of guinea-pigs which had died in his laboratory at Sassari, after a wasting illness of about twenty days' duration. The organism grew as a small non-motile micrococcus arranged in tetrads and usually inclosed in a capsule; it stains readily with anilin dyes and by Gram's method; it does not grow below 15° C. and flourishes best at 37° C., but on various media the growth is slight; in broth it forms a fine dusty deposit, the medium remaining clear; if blood-serum is added to the broth the growth is more abundant and the fluid is clouded; it does not coagulate milk; on agar it forms small round granular colonies with jagged margins; on serum-agar the colonies are larger and may become confluent; on nutrient gelatin growth is scanty and slow, appearing only after 2 to 3 months, the colonies having a brown tint and granular structure; the gelatin is not liquefied; glucose is not fermented. Animal inoculation gave negative results.

Organisms of the Gaertner Group.‡—W. D. Savage finds that fuchsin-agar and lactose-bile-salt-neutral-red-agar are media which allow the organisms of the Gaertner group to be sharply differentiated from those of the *B. coli* group, and are valuable for isolation purposes. Malachite-green 0·05 p.c. exerts an inhibitory action upon the growth of *B. coli*, and the author obtained good results in the isolation of

* Centralbl. Bakt., 1te Abt. Orig. xlviii. (1908) p. 125.
† Tom. cit., p. 42. ‡ Rep. Local Govt. Board, 1906–7, p. 253.

Gaertner organisms when dulcite broth containing 0·05 p.c. of malachite-green was employed. In view of the possibility that not all the members of this group will flourish in 0·05 p.c. malachite-green broth, the author advises that direct plating methods should also be used.

Animal inoculation methods are not trustworthy, since it is not uncommon to obtain Gaertner organisms from the heart-blood of animals that have been inoculated with organisms other than those of the Gaertner group: the pathogenic effects of the *B. coli* group may entirely mask those produced by the Gaertner group; and it is also possible that Gaertner group organisms may be present but non-virulent.

The author examined the intestinal contents of some healthy animals: three bullocks, six pigs, and one calf; he found in the bullocks no organisms resembling those of the Gaertner group; from five pigs organisms culturally resembling *B. paratyphoid A* were isolated; only four bacilli were isolated from the pigs which culturally were allied to the other Gaertner sub-groups, and of these one did not ferment dulcite, while the other three fermented saccharose; none of these organisms were agglutinated by sera obtained from rabbits immunised from well-known members of the Gaertner group. The calf showed both in the colon and cæcum numerous organisms culturally indistinguishable from the ordinary Gaertner group bacteria, but when tested against different immune sera these organisms were not agglutinated; they were, however, highly pathogenic, and the author considers that further research is needed to determine to what extent these organisms are common in calves, and whether their presence is hurtful to those using such animals.

Bacterial Studies of Milk.*—W. G. Savage finds that streptococci were present in the majority of samples of milk taken from healthy cows; no cocci resembling the *Diplococcus intracellularis meningitidis* were met with; staphylococci were found in large numbers in most of the plates made from centrifuged milk deposits, and were recognised as two distinct classes; bacilli were only occasionally met with, and in scanty numbers.

The author groups the streptococci morphologically, according to length of chain, into short, medium, and long, and biologically according to their reaction with different sugars and alcohol media, and also according to their pathogenicity, as shown by their action on mice, although in this respect, out of twenty-five streptococci, the virulence of which was tested, the results were in every case negative.

The author finds that the mere presence of streptococci bears no relation to the existence of local condition of the cow, the number of calves, or the stage of pregnancy; but there seems to be a connection between local condition and the presence of a certain kind of streptococcus. This variety forms long chains; stains by Gram's method; grows at 21° C. and at 37° C.; clots milk within 3 days; ferments lactose, saccharose, and raffinose (and usually salicin), whereas mannite, coniferin, and inulin are unaffected. This organism was isolated from the milk of seven cows, three of which had ulcerated teats, and a fourth had nodules at base of two teats.

Referring to the staphylococci present in milk, the author considers

* Rep. Local Govt. Board, 1906–7, p. 205.

they are without significance. In the milk from six healthy cows and three cases of mastitis, diphtheroid bacilli were met with, but were probably of no significance.

Considering the presence of leucocytes in milk, the author found they varied in number within very wide limits, independent of the age of the cow, the number of calves, the period since calving, and the stage of pregnancy; but present or past mastitis causes a high count of leucocytes.

Pyogenic Cocci.*—F. W. Andrewes and M. H. Gordon agree with other observers in failing with Wright's capillary pipette method to obtain evidence of any bactericidal effect exerted upon *Staphylococcus pyogenes aureus* (1) by human blood; (2) by normal and immune rabbit's blood; (3) by normal and immune horse serum; or (4) by normal horse serum in the presence of living leucocytes.

The authors find that *S. pyogenes aureus* rapidly perishes at 37° C. in distilled water, tap-water, or in water containing salts or organic substances incapable of serving as nutriment for the cocci; but that the addition of a trace of proteid material permits survival and multiplication of cocci, which is apparent within two hours. By exposing *S. pyogenes aureus* to normal rabbit's blood, a marked bactericidal action was noted during the first few hours of contact, but which was exhausted by the end of 3 to 4 hours; the action was more marked with immune rabbit's blood. Previous exposure for half an hour to 55–56° C. diminishes this action. By previously saturating the defibrinated rabbit's blood with killed cocci, the bactericidal substance was removed. Similar results were obtained by using serum in place of blood, and also by employing human blood and human serum.

Micro-organisms in Sewer Air.†—F. W. Andrewes finds that streptococci, isolated from drain air, correspond biologically with those of sewage, and only to a slight extent with the streptococci abounding in fresh air; the type of streptococci most abundant in fresh air are not found in the air of sewers and drains. The author has also shown that the bacilli of the colon group, obtained from drain air, correspond biologically with those of sewage, and can only rarely be isolated from fresh air.

When cultures of *Bacillus prodigiosus* were added to the contents of drains under suitable conditions of splashing, the organism can be recovered from the drain air at distances of 50 feet and 390 feet from the point at which they were added to the sewage.

The author concludes that under certain circumstances sewage may give up its bacteria to sewer air.

Micro-organisms and Rheumatic Fever.‡—T. J. Horder finds that in cases of rheumatic fever, no micro-organisms can be grown in cultures made from the blood during life, or from the heart-blood, endocardial vegetations, pericardial and pleural exudates in fatal cases; that in most cases film preparations are negative.

Cultures, made during life, from the blood in cases of malignant

* Rep. Local Govt. Board, 1906–7, p. 141.
† Tom. cit., p. 183. ‡ Tom. cit., p. 279.

endocardites yield 90 p.c. of positive results. The organisms thus obtained are not of the nature of terminal infection, but are causal elements of the disease. In 77 p.c. of cases streptococci are found; Pfeiffer's (*Bacillus influenzæ*) in 6 p.c. The streptococci conform to the salivary and fæcal types, defined by Gordon and Houston, and differ little from the saprophytic streptococci of the mouth and intestine; when isolated from cases of malignant endocarditis they can reproduce the disease when injected intravenously into rabbits, and can be recovered from the lesions. Similar results can be obtained by injecting saprophytic streptococci, isolated from normal human saliva or fæces.

New Acid-fast Bacillus.* — G. Basile isolated from a case of gangrene of the lung a non-pathogenic acid-fast bacillus resembling *B. tuberculosis* in its cultural characters, its morphological aspect, and in its staining reactions. The chief differences were that it was decolorised a by 2 p.c. alcoholic solution of lactic acid in a few minutes, while Koch's bacillus resisted for half an hour; it grew readily in broth, or on gelatin or glycerin-agar in 24 hours, and was only feebly and locally pathogenic to guinea-pigs.

Anaerobic Pseudo-coli Bacillus.†—M. Jungano isolated from the stools of an infant an essential anaerobe which morphologically might be mistaken for *B. coli*. In fæcal matter and on solid media, it presents itself as a coccobacillus with rounded ends, staining less deeply in the centre. In liquid media bacillary forms predominate. It is easily stained, but not by Gram's method. It is motionless, and forms terminal spores. It does not form gas or indol, nor coagulate milk. When injected into the peritoneal sac of guinea-pigs a definite capsule is developed. It is pathogenic to guinea-pigs, and is very resistant to thermal and chemical action.

Bacillus parvus liquefaciens.‡ — M. Jungano describes a new organism which has the following characters: It is an essential anaerobe, is small, and very polymorphic. It stains with the usual anilin dyes, and is Gram-positive; in old cultures the organism does not stain uniformly. Other positive characters are: that it coagulates milk, liquefies gelatin, is pathogenic to guinea-pigs, forms acid, and has considerable vitality.

R. Greig-Smith—**Opsonisation from a bacterial point of view, and Opsonic Technique.** *Proc. Linn. Soc. N.S.W.*, xxxiii. (1908) pp. 669–700.

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* Giorn. Internat. Sci. Med. Naples, xxx. (1908) p. 577. See also Brit. Med. Journ., 1908, ii. epit. 341.

† C.R. Soc. Biol. Paris, lxv. (1908) pp. 457–9 (2 figs.).

‡ Tom. cit., pp. 618–20.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Reichert's Demonstration Microscope.†—This instrument (No. 115 in the maker's catalogue), is shown in fig. 7, and will be easily understood from the illustration. A prominent feature is the hand-grip bow.

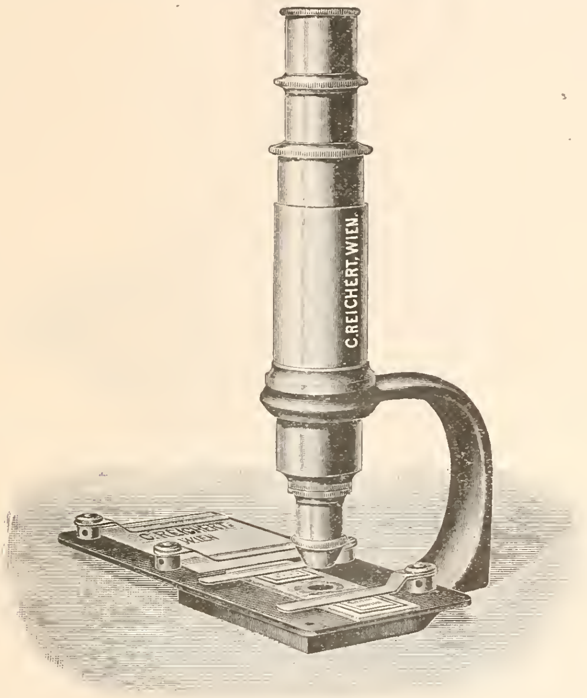

FIG. 7.

Watson's "Standard" Microscope.‡—This instrument (fig. 8) is of a new type, in which the milled head of the fine-adjustment is placed at the side of the limb. The foot and limb are of solid brass. The coarse-adjustment is of the diagonal rackwork and spiral pinion form. The fine-adjustment, one rotation of the milled head of which raises

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† C. Reichert, Vienna, Catalogue, Mikroscope, No. 36 (1908) p. 46.

‡ Watson and Sons, Ltd., Catalogue, 1909, pp. 54–5 (fig.).

or lowers the body $\frac{1}{250}$, is effected by a coned pin of steel, a steel roller being kept in contact with the cone by a reactionary spring. The body-tube is 145 mm. long, and by extension of the draw-tube is 225 mm.

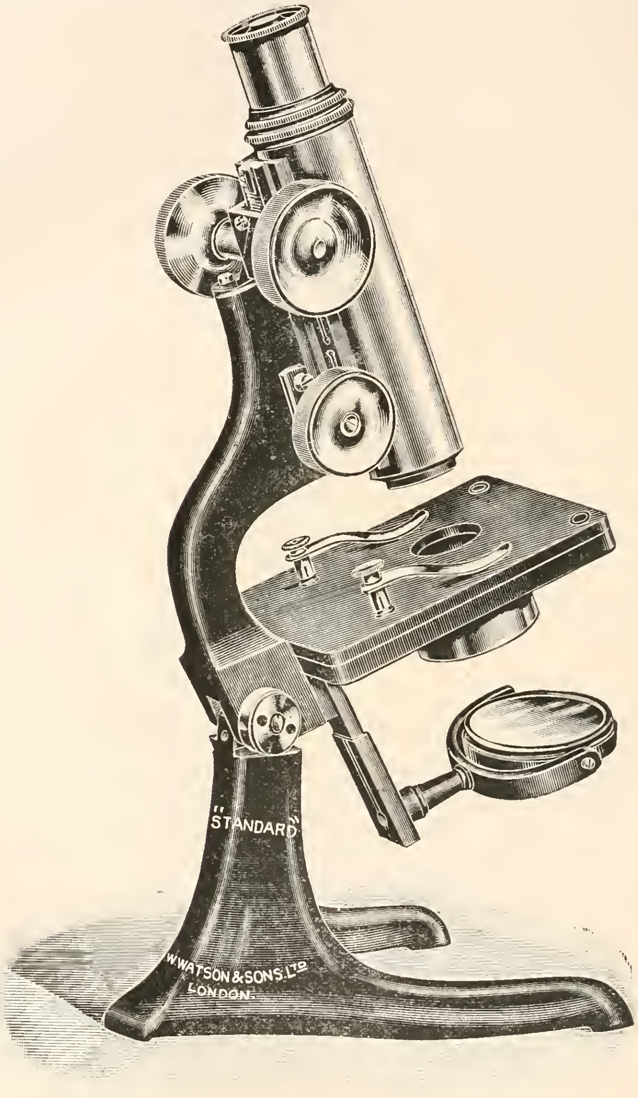

Fig. 8.

The stage, $3\frac{1}{2}$ in. square, is covered with ebonite and fitted with grip stage springs. The instrument is adapted for either compound, rackwork substage, or spiral focusing substage.

Watson's "Club" Portable Microscope.*—This instrument (fig. 9), adapted for travelling purposes, is rigid and compact, and can be stowed away in its case without taking any parts to pieces. The legs fold back-

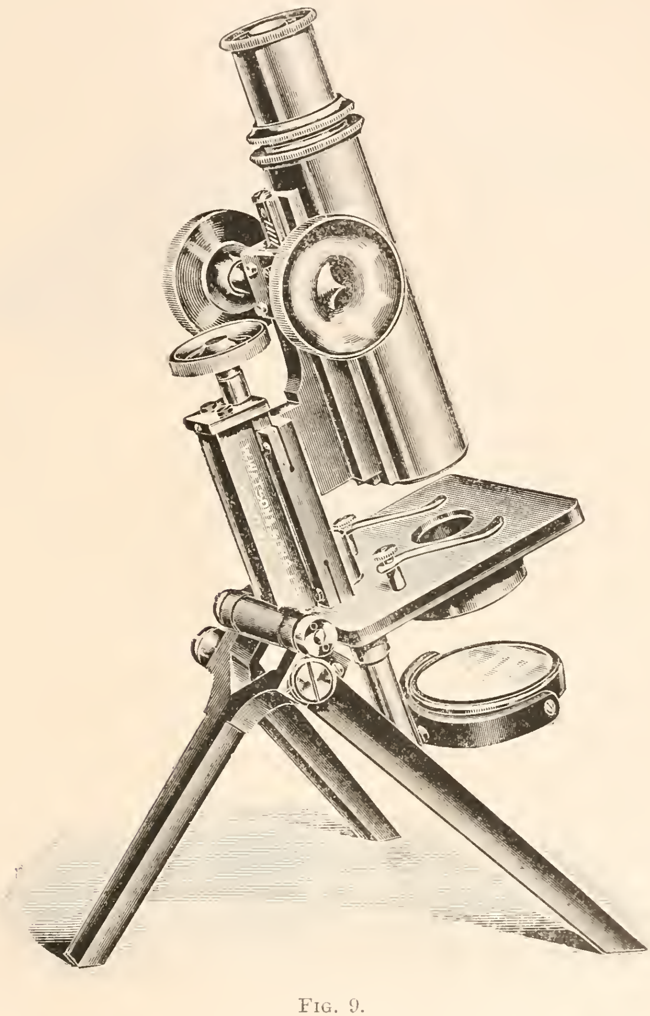

FIG. 9.

wards around the limb; the mirror tail-piece pushes upwards through the stage, and there is sufficient space in the leather case for eye-pieces and objectives.

* Watson and Sons, Ltd., Catalogue, 1909, p. 66 (1 fig.).

Watson's "Simplex" Dissecting Microscope.*—This stand (fig. 10) is adapted for the firm's aplanatic magnifiers mounted for dissecting. For focusing it is supplied with a spiral-screw adjustment, and it is

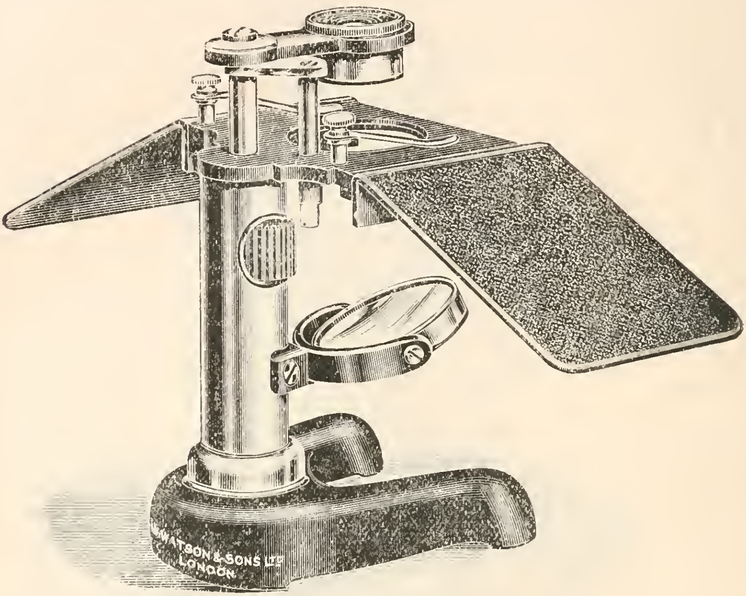

FIG. 10.

fitted with a glass disk for stage, a plane mirror and matt opal reflector, and hand-rests.

(2) Eye-pieces and Objectives.

Bifocal or Multifocal Lenses.†—Under the title of "An Interesting Lens" the English Mechanic describes an improved method of manufacturing bifocal lenses. It will be seen that the method may be applied to multifocal lenses. The process consists in so uniting two or more bodies of glass, differing in index or kind, while both bodies are in a molten state, and in so shaping the united bodies, while molten or plastic, that bifocal, achromatic, and compound or toric lenses can be produced by simple grinding. By uniting white and coloured glasses of the same or different indices a lens may be produced having a coloured and a clear portion. By joining the different kinds of glass in such a manner while both are in a molten state the blank, from which the finished lens will be subsequently formed, may be blown, pressed, rolled, or otherwise shaped into spherical, cylindrical, or curved shapes, as may

* Watson and Sons, Ltd., Catalogue 1909, p. 70 (1 fig.).
† English Mechanic, lxxxviii. (Nov. 20, 1908) pp. 367–8 (6 figs.)

be desired. Although it is possible to form the blank by rolling or pressing, the inventor of the process, W. J. Seymour, of the Merry Optical Co., Kansas City, prefers to form the blank by blowing the united bodies. He accomplishes this by gathering on the end of a blowpipe a body of glass of a certain kind, or index, or colour, and by then dipping it into a pot of molten glass of a different kind, index, or colour. In the action of dipping care must be taken that the molten glass moves progressively along the body, thereby washing away any air-bubbles, foreign matter, or imperfections on the surface of such body; this, moreover, insures a perfect union between the two layers. The body of glass, consisting of the two uniting layers, may be shaped by blowing alone, but preferably by blowing in a suitable mould in the manner well known in the art of blowing, so as to insure regularity and

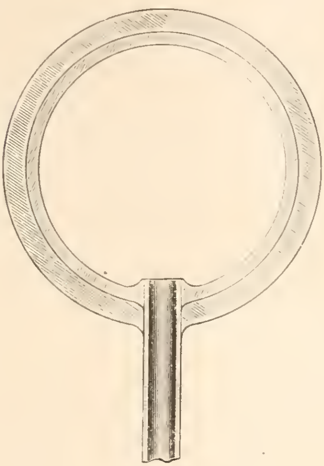

FIG. 11.

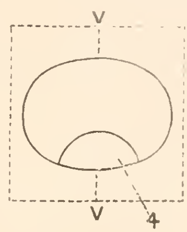

FIG. 12.

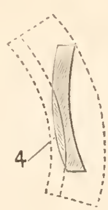

FIG. 13.

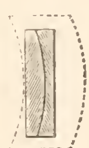

FIG. 14.

uniformity of contour (fig. 11). After the shell, consisting of two or more layers, has been produced a section or blank (shown by dotted lines in figs. 12, 13, 14) is cut from the body of this shell. This section is then ground so as to form a lens (shown in full lines in figs. 12, 13, 14) which is made up of a plurality of kinds or colours of glass. In making bifocal lenses the blank is ground to the shape shown in full lines, so that the different focal centres are placed in the desired parts of the finished lens. Thus a lens is secured of as many focal powers as desired, the number being dependent upon the number of glass layers of different kinds, index, or colour, which have been formed into one integral body, the arrangement of the focal centres being adjusted by the grinding process. It will be understood that in grinding a bifocal lens from a blank which has been formed by this process one or more of the layers of which the blank is composed may be cut entirely away, except for a portion of the lens surface, and thus a lens will be produced having a number of foci. In fig. 14 is shown an achromatic lens formed by grinding the outer surfaces of the blank, the uniting surfaces between the two layers being properly curved in forming the shell.

(5) Microscopical Optics and Manipulation.

Microscopic Measurements.* — A correspondent, J. D., in the English Mechanic, points out the too frequent omission of information as to the real sizes of objects delineated in book-illustrations of microscopic objects. Even when a size is given (e.g. × 200), such a statement is incomplete unless the particular combination of the eye-piece and objective used is stated. The writer suggests that it might be desirable to give the magnification obtained in microns (e.g. 100μ). He also emphasizes the convenience of the squared eye-piece micrometer, and points out that it may even be used for angular measurement. If the left-hand bottom corner of a group of squares be regarded as the centre of a circle, radii may be imagined intersecting the horizontal and perpendicular lines where they cross one another. Taking the bottom line as radius, the tangential perpendiculars may be expressed as decimal fractions of this radius, from which decimals the included angles can be found by inspection in any table of natural tangents, and other angles thereby estimated. On the same principle the angles round any point of intersection, within the group of squares, may be easily determined and tabulated, if likely to be of use; and for angles above 90°, the choice of a suitable centre, conjoined with a little additional calculation, is all that is necessary.

(6) Miscellaneous.

Gage's Microscopy.†—The Microscope: an Introduction to Microscopic Methods and to Histology, by S. H. Gage, has quite recently reached the 10th edition. The work has been practically re-written, and though retaining the well-known features which have rendered it so popular and valuable, a vast amount of information as to recent advances and improvements in Microscopy and Technique has been added, more especially in the direction of Histology. To enter into detail as to its merits would nowadays be superfluous, but it is permissible to state that this text-book will be found of the greatest service to teacher as well as student, whether they be of the "brass and glass" or "bug and slug" tendency.

Cholesterol, Fluid Crystals, and Myelin Forms.‡ — C. Powell White draws the following conclusions from facts ascertained after many complicated experiments. The potassium salts of "oily" fatty acids can be obtained in a crystalline fluid condition, which probably represents a hydrate of the salt. In aqueous solutions of these salts (where the corresponding acid is insoluble in water) cholesterol and some other substances give myelin forms, which are due to variations in surface

* English Mechanic, lxxxviii. (1908) p. 356.
† Comstock Publishing Co., Ithaca, New York, 1908, 345 pp. (258 figs.).
‡ Med. Chron. (1908) pp. 1–19.

tension acting on the cholesterol fatty acid mixture. This mixture is quite different from the corresponding ester, the acid presumably existing as an "acid of crystallisation." Anisotropic globules and myelin forms occurring in the tissues are, therefore, no evidence of the presence of oleates or cholesteryl esters as suggested by Adami, Aschoff, and others. Anisotropic globules and anisotropic myelin forms are probably identical in structure, though differing in shape; it is possible that their presence in some tumours has given rise to the suggestion that "parasites" were responsible for the condition. Finally, the association of cholesterol and fatty acid in unstable combination being so frequent, it may be deduced that cholesterol has an important place in the processes of fat metabolism.

Crystals in Tumours.*—C. Powell White, as the result of various micro-chemical experiments, comes to the following conclusions: (1) That crystals consisting of a loose combination of cholesterin with fatty acids, lecithin, or other substances occur in or among the cells of malignant tumours, and in some other conditions. (2) These crystals seem to be associated with cell proliferation rather than with cell degeneration, in which condition simpler crystals of fat, fatty acids, or cholesterin are more usual. (3) There are grounds for supposing that cholesterin may be in some way associated with the regulation of cell proliferation.

Crystals in Fat-cells.† — T. Lorrain Smith and C. Powell White conclude that the crystals found in fat-cells, hitherto spoken of as margarine, margaric acid, stearic acid, etc., are in reality those of neutral fats.

Quekett Microscopical Club.—The 451st Ordinary Meeting was held on November 6, 1908, the President, Professor E. A. Minchin, M.A., F.Z.S., in the chair. Reference was made to the death, on October 11, of Mr. W. Saville Kent, F.L.S., F.Z.S., etc., author of the well known manual of Infusoria. The President exhibited and described a number of preparations of blood-parasites—trypanosomes and trypanoplasms—of fresh-water fish, chiefly from the Norfolk Broads. It was supposed that the infection of the fish was effected by leeches. The group was entirely confined to the Vertebrates; nearly every known species was the host of a trypanosome, but very many are quite harmless. Mr. T. A. O'Donohoe read a note on "The Photographic Evolution of the Fine Structure of the Podura Scale." He had photographed the fine mycelioid structure and minute horizontal filaments joining the vertical lines described by Mr. Nelson (see this Journal, 1907, p. 400). Mr. F. P. Smith contributed a paper on "Some British Spiders taken in 1908." He also gave a lecture, illustrated with lantern slides, on "Flies, from several points of view." The "points of view" dealt with were those of the man at the museum, the individual who recognises some 40,000 species of flies, then the man with the Microscope, and the man with the pocket-lens. Following these were the man at the farm, the medical man, and the man in the street, and the final view-point—a consideration of those creatures which assisted in the destruction of superabundant flies.

* Journ. Pathol. and Bact., xiii. pp. 3–10.

† Med. Chron., 1907.

The 452nd Ordinary Meeting was held on December 4. A new growing cell for use with the highest powers, designed by Mr. A. A. C. Eliot Merlin, F.R.M.S., was exhibited by Messrs. Baker. Mr. D. J. Scourfield, F.Z.S., F.R.M.S., gave a lecture, illustrated with lantern slides, on "The Locomotion of Microscopic Aquatic Organisms." The organisms discussed included *Amœba*, flagellated organisms, and those with cilia. Other more specialised types were dealt with, such as those with medusoid motions, the methods adopted by Nematodes and by *Salpa*, and the highest form of locomotion—that due to appendages actuated by muscles—in more complex forms.

At the 453rd Ordinary Meeting, held on January 1, 1909, Mr. A. Earland gave a lecture, illustrated by a large number of specimens under Microscopes, on "The Selective Powers of Arenaceous Foraminifera." The preparations shown were chosen to show the great diversity of structure and technical skill exhibited in the tests of this group. Nearly every species has well marked characteristics, which serve to distinguish its test from those of closely allied forms, and nearly all possess the power of selecting material, which, when considered in relation to the extremely low organisation of these animals, can only be regarded as wonderful. This selective power reaches its highest development in the genus *Technitella*, but varies in different species. A new and as yet undescribed species of this genus was shown, which built its test entirely of calcareous plates from Echinoderms.

Rules for the Sections and Sectional Meetings.—Sections for the informal study and discussion of such branches of science connected with the Microscope and its use as may from time to time be sanctioned by the Council may be formed by voluntary association on the part of not fewer than ten Fellows of the Society, subject to the following rules:—

1. Membership of the Sections shall be open to all Fellows. Any Fellow joining one or more of the Sections shall signify his adhesion thereto and his acceptance of these rules by signing a book to be retained in the custody of the Hon. Secretaries of the Society.

2. The general management of each Section shall be vested in a Committee consisting of a Secretary and four other Members of the Section. The Committee shall be elected at the first Meeting of the Section in each year. Any vacancies occurring during the year shall be filled up by election by the remaining Members of the Committee. The Sectional Committees shall be responsible to the Council for the proper management of their respective Sections.

3. Each Sectional Secretary shall keep a list of the Members of his Section and an attendance book to be signed by all persons attending a Sectional Meeting. He shall report to the Council any infringement of these rules, or any matter connected with the Section that may appear to him to be necessary. He shall also report any other matter on which the Council may desire to have information. He shall not be required to keep any Minutes or other record of the proceedings of his Section.

4. Sectional Meetings may be held in the Society's Rooms at any convenient time between 6 p.m., and 10 p.m., on any Wednesday except the third in each month, from November to June.

5. Only one Sectional Meeting shall be held on any one evening, the dates of Meeting for each Section to be fixed by the Sectional Secretaries in agreement with the Assistant Secretary of the Society.

6. Visitors may be present at Sectional Meetings on the invitation of Members of the Sections.

7. No account of the proceedings at the Sectional Meetings shall be published in any form whatever, except such as the Editor may think fit to publish in the Journal of the Society, and no action shall be taken by the Sections which would involve the Society in any financial or other liability.

8. Any Member of a Section may withdraw therefrom upon notice given to the Secretary of the Section, and he shall cease to be a Member if he discontinues his attendance at the Meetings of the Section for the period of a whole Session, or if he ceases to be a Fellow of the Society. In case the Membership of any Section shall fall below the number of five and continue to be less than five for the period of a Session of the Society, that Section shall be dissolved and automatically become extinct at the end of that Session. Any Section may at any time be dissolved by a resolution of the Council of the Society.

9. The Council may suspend any Fellow from Membership of a Section for the infringement of any of these Rules or for any other reason it may deem sufficient.

Note.—For the present the Sections authorised are as follows :—

A. Microscopical Optics and Microscope Construction Section (Brass and Glass).

B. Biological Section (Pond Life and Microscopical Organisms generally).

C. Bacteriological Section (Histology, Bacteriology, Disease-producing Organisms, etc.).

These Sections have been duly constituted, and are now meeting as follows :—

1st Wednesday	at 8 p.m.	Bacteriological.
2nd ,,	,, 7 for 7.30 p.m. .	Biological.
4th ,,	,, ,, . . .	Brass and Glass.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Marine Expeditions.†—A. G. Mayer laments the loss of time, the waste of money and energy of the numerous marine expeditions organised by civilised nations, and then describes his plan for obtaining more valuable results. It is an improvement on the general practice which has hitherto obtained, viz. that of sending out a collecting vessel and relegating the catches to experts at home. For this procedure the author would establish shore stations, properly equipped in all respects, i.e. as to men and material. These stations would be served by the

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, etc.; (6) Miscellaneous.

† Science, xxvii. (1908) pp. 669–71.

collecting steamer, on which would reside a small permanent staff, and would be suitable for the transport of the staff and material of the shore stations.

The author also points out some of the marine problems on which much light would be thrown by adopting his suggestions.

Methods of Plankton Research.*—W. J. Dakin, in an interesting and very useful paper on Planktonology, continues a description by J. T. Jenkins in 1901 of the nets and methods invented and devised by Victor Hensen. The author describes plankton nets; method of using the quantitative net; preservation and estimation of the catch; pump, tube, and filter method; method of investigation for the smallest organisms; other plankton apparatus used for qualitative work; and then gives a summary of the results of the plankton work and its aims.

The author had personal experience of the acquaintance with the apparatus he describes on the occasions when he was permitted to accompany the German expeditions in the North Sea and Baltic.

Behaviour of Certain Pathogenic Micro-organisms at Low Temperature.†— E. Almquist finds that certain strains of *Bacillus paratyphosus* and *B. coli* grow well on agar slopes at 10° C.; but the organisms of cholera, typhoid, and dysentery grow only feebly, and appear as coarser forms, which produce germinating granules (kugeln). If these forms are transferred to fresh medium at a higher temperature they rapidly produce "granules," which begin to germinate at once. The earlier forms thus produced are non-motile; the cholera granules quickly give rise to comma-bacilli, and can also form new granules; the typhoid and dysentery granules may form new granules, but usually only give rise to rods.

The author found the same developmental processes occurred with all strains of cholera and dysentery organisms, but not with all examples of *B. typhosus*.

Differentiation of Bacilli of Typhoid Group.‡—G. C. Chatterjee employs the following tests for differentiating the organisms of the typhoid group. *Bacillus typhosus* is grown on agar slopes, the whole surface being inoculated; after 3 to 4 days at 37° C., all visible growth is washed away by sterile normal salt solution; if these washed surfaces are re-inoculated with *B. typhosus*, no growth occurs, but if inoculated with *B. paratyphosus A*, or *B. paratyphosus B*, Shiga's bacillus, or *B. coli*, growth occurs in all tubes after 48 to 72 hours at 37° C. Similar tests are made with scraped agar cultures of *B. coli*, *B. paratyphosus A*, etc., with similar results, except in the case of *B. coli*, where the scraped surface has a growth-inhibiting effect not only on *B. coli* but also on *B. typhosus* and bacilli of the typhoid group.

The author concludes that the bacilli produce in the agar a specific growth-inhibiting toxin, which is insoluble in salt solution; it is destroyed at 55° C. for one hour: though inhibiting growth it does

* Proc. and Trans. Liverpool Biol. Soc., xxii. (1908) pp. 500–52 (7 figs.)
† Centralbl. Bakt. 1te Abt. Orig., xlviii. (1908) p. 175.
‡ Tom cit., p. 246.

not kill the bacilli: this specific property can be used to identify *B. typhosus* from other allied bacilli.

Achromogenic Cultures of Micrococcus prodigiosus.*—M. Cordier, H. Rajat, and G. Péju placed open agar-tube cultures of *Bacillus prodigiosus* in a 150 c.cm. flask filled to one-third with sulphuric ether: a glass vessel, part full of cotton wool, was inverted over the whole, covering at the same time the opening of the culture tube and of the flask; after standing in the dark, at the temperature of the laboratory, growth slowly appears, but of a white porcelain aspect, and showing no trace of pigment. A control tube, inclosed in a similar flask containing water, showed typical pigmented cultures.

If the achromogenic cultures are transferred to fresh media, the subcultures are also free from pigment, but after a few generations the red colour reappears. The author finds that the longer the duration of cultivation in ether vapour, the slower is the reappearance of pigment in subcultures; but a true achromogenic variety cannot be permanently obtained. Similar results were observed by substituting ethyl- or methyl-alcohol, chloroform and xylol for ether.

Blood Cultures.†—Lafforgue adopts the following procedure for blood cultures. The blood is obtained by venous puncture and mixed with citrate of soda: one drop ($\frac{1}{50}$ c.cm.) of 20 p.c. citrate solution to 1 c.cm. of blood. The mixture is centrifuged and the supernatant liquid decanted, and the deposit is distributed into flasks or tubes of broth. The removal of the serum, which contains comparatively very few germs, is not likely to cause serious error, and at the same time its slightly inhibiting action is also removed.

The method is economical, and permits the transmission of blood specimens, without any liability to interfere with subsequent bacteriological investigation.

Action of Meningococcus and similar organisms on Sugar Media.‡ C. Dopter and Raymond Koch employ the following media for studying the action of meningococcus and allied organisms in various sugars. To 75 c.cm. of slightly alkaline agar is added 1 grm. of lævulose, dextrose, or maltose, etc.; after sterilisation there are added 25 c.cm. of ascitic fluid, and 1 c.cm. of sterile 1 p.c. solution of neutral red; the mixture has an orange tint, and is kept in a water-bath at 60° C. for 1 hour, until the formation of a fine precipitate of neutral red occurs. The medium is then poured into Petri dishes—it has a yellowish tint in thin layer—and cultures are made for meningococcus, pseudo-meningococcus, and gonococcus, and incubated at 37° C.

The authors find that meningococcus, after 24 hours on dextrose and maltose, gave a carmin-red colour: on lævulose and other sugars no fermentation occurs. The coccus *catarrhalis* is without action on any sugar. Flavus i. and ii. ferment lævulose, dextrose, and maltose, but Flavus iii. has the same reactions as meningococcus.

Diplococcus crassus (*Pseudomeningococcus* Jaeger) ferments most all the sugars. Gonococcus only ferments dextrose.

* C.R. Soc. Biol. Paris, lxv. (1908) p. 344.
† Tom. cit., p. 340. ‡ Tom cit., p. 351.

(2) Preparing Objects.

Researches on the Leucocytes and Lymphoid Tissue of Invertebrates.*—M. Kollmann fixed the material with Zenker's fluid (with and without acetic acid), Lindsay's fluid, and in certain cases with Dekhuysen's mixture (potassium bichromate 6·25 grm., filtered sea-water 250 c.cm., 2 p.c. osmic acid 54 c.cm.). The last fluid is isotonic with sea-water, and gives excellent results for very delicate elements. In some cases, Gastropods, Lamellibranchs, and Echinoderms, the plasma being deficient in albumen coagulates in flakes, and does not stick to the slide. Various devices to meet this emergency must be resorted to, the only one mentioned being that of Regaud, which consists in collodionising the slides. For staining the films the following were used: hæmatoxylin-eosin-orange, toluidin-blue-eosin-orange, safranin-light-green, magenta-Benda. For the granules, the triacid, the C mixture of Ehrlich and Giemsa, were used. For the lymphogenic organs, the same fixative which succeeded best with the blood was used, while for demonstrating the stroma, 2 per thousand potassium bichromate, or Merkel's fluid, was substituted. Sections were made by the gum method, but if the presence of a network can be detected by the naked eye, the paraffin method may be adopted.

The author then describes his method of making a differential count of the corpuscles. A drop of blood is obtained by means of a pipette; this is spread on a slide fixed with osmic acid vapour, dried and stained with triacid. All the corpuscles in the whole of the film are then counted and classified. It is advisable to count several thousand.

(4) Staining and Injecting.

Bacillus of Anthrax and Silver Impregnation.—J. Yamamoto finds that young vegetative forms of *Bacillus anthracis* are silver-negative, only the contour staining as a sharp black line; in older forms, when spore-formation is commencing, the entire bacillary body is diffusely stained, more especially at the centre, but also at other points black flecks are found which later become larger and circumscribed, and appear as spores. In older cultures they stain less well. These observations applied to cultures on all the media investigated.

The bacilli in smears from heart-blood or in organs from an anthrax-infected mouse, are not so constantly silver-negative, many organisms showing a black stain; the capsule remains unstained, as is the case with other encapsuled bacteria.

Staining of Fat with Basic Anilin Dyes.‡—J. Lorrain Smith says that if a section of fat-containing tissue be stained with an aqueous solution of a basic anilin dye, and then exposed to the air in a thin layer of Farrant's solution for 2 or 3 days, the fat will attract the dye from

* Ann. Sci. Nat. Zool., viii. (1908) 240 pp. (2 pls.).
† Centralbl. Bakt., 1te Abt. Orig., xlviii. (1908) p. 253.
‡ Journ. Pathol. and Bact., xii. (1907) pp. 415–20.

adjacent tissues and stain deeply. This is due to the carbonic acid of the air converting the neutral fats into fatty acid and glycerin, the former taking up the basic stain very readily. CO_2 produces a parallel change in carbohydrates, glycogen, and possibly proteids. This method may be expected to throw light on the action of excessive CO_2 in the blood, it also affords an explanation of why the tubercle bacillus with its fatty capsule is "acid-fast." The acid rather fixes the dye than fails to remove it. In the case of the *Smegma* bacillus the compound so formed is very soluble in alcohol; in the case of tubercle it is less so, i.e. tubercle is also "alcohol-fast."

Simultaneous Staining by Oxazine Dyes.* — The same author describes an investigation on the staining of fat by oxazine dyes, undertaken with the view of finding a stain which would, in the same section, differentiate neutral fat from fatty acid.

Nile-blue, and certain other dyes of the oxazine series, are capable of being converted into a red compound, and aqueous solutions of (e.g.) Nile-blue are found to contain two bases, a blue oxazine base which forms a blue soap with fatty acid, but does not combine with neutral fat, and a red oxazone base which is soluble in and colours both fatty acid and neutral fat. The oxazone base can be obtained from the oxazine by heating with a little sulphuric acid.

The practical application of this method of fat-staining requires further elaboration; but to give an example of the results obtained, it was found in sections of liver from cases of obstructive jaundice that the fat adjacent to the congested bile-ducts stained deep blue; and that more remote, purple or red. This may be presumed to indicate that the action of the bile is instrumental in converting neutral fat into fatty acid.

Principles of Weigert's Method.†—According to J. Lorrain Smith and W. Mair, there are certain substances of a fatty nature present in most tissues which are able to combine with chromium oxide; the compound so formed will lake hæmatoxylin, i.e. will "stain." The chromium-oxide compound is best obtained by keeping the unsaturated substances in a concentrated solution of potassium dichromate at incubator temperature (37° C.) for some days; but if this action be allowed to continue too long, the compound capable of laking hæmatoxylin is converted into a fully saturated compound which is unstainable, or "overchromed."

The spinal cord contains various elements differing in the rate at which they oxidise, so that by stopping the bichromating at different stages we can stain separately, first the medullary sheath, then in order the nucleoli, the axis-cylinder, the cell-body and processes, and, lastly, the neuroglia. If the bichromating be longer continued, no staining at all takes place, all the unsaturated groupings being occupied.

Even entirely unsaturated fats, however, stain less readily than the medullated nerve-sheath, and this seems to depend on the presence in

* Journ. Pathol. and Bact., xii. (1907) pp. 1–4.

† Op. cit., xiii. (1908) pp. 14–27.

the latter of substances which, on examination by crossed Nicol prisms, are found to be anisotropic. These substances appear as globules, or "myelin figures"; they are normal in the suprarenal gland, and occur very frequently in pathological tissues, characterising a most important type of fatty degeneration. These substances are composed of fatty acids and cholesterin, neither of which will stain separately; but if the two are present in a "myelin-like" compound, staining or oxidisation immediately takes place. Several experiments make it almost certain that cholesterin is the substance oxidised. This seems to throw fresh light on the part which cholesterin plays in cell-metabolism. Two other constituents of the medullary sheath, viz. lecithin and protargon, do not seem to be concerned in the results of Weigert's myelin method, which would appear, then, to depend on the existence in the medullary sheath not merely of unsaturated fats, but of such in the form of a compound with cholesterin, which gives "myelin figures" when heated in contact with water.

(5) Mounting, including Slides, Preservative Fluids, etc.

Mounting Amphibian Eggs.*—K. Ogushi describes a procedure for mounting eggs of Amphibia for demonstration purposes. It consists in immersing the eggs in 0·5 p.c. formalin, after previous fixation in chrom-acetic acid, Zenker's fluid, or sublimate. In about six months the gelatinous sheath has dissolved away. The next step is to make a very thick ring on a slide with balsam by aid of the turntable. The circular well is then filled up with the prepared roe and closed by means of a cover-slip, previously heated. After pressing down the slip, the margin should be further secured by means of some varnish. The slides should be allowed to rest for some months.

(6) Miscellaneous.

Photomicrographic Atlas of Fibres important in Arts and Commerce.†—The first part of this atlas (the sub-title of which is A Manual of Microscopical Research Methods for materials used in textile fabrics, in the manufacture of paper, rope, string, and yarn) has recently appeared. The author is Alois Herzog, one of the principals in the Prussian High School at Sorau, where there is a special textile industry department. The work, which is subsidised by the Prussian Government, represents the results of fifteen years' labour. In the text are described the apparatus required, the necessary technique, the microchemical reactions, and the microscopy of the fibres and of the plants from which they are derived. The atlas contains 222 photomicrographs, one being in three colours. These are all most excellent, and of course are faithful reproductions of the originals. This atlas will form one of the most valuable works on this particular branch of microscopy, and will be of the greatest assistance to students and learners.

* Anat. Anzeig., xxxiii. (1908) pp. 381–2.
† Munich: J. B. Obernetter, 1908.

Apparatus for the Aeration of Aquaria.*—B. Jöckel describes the following arrangement (fig. 15) for aerating aquaria. The completely closed cistern A is connected by the tube W with a water supply; through an opening in the top of A is passed a siphon tube H that reaches nearly to the bottom, and has its free arm ending as low as possible below the vessel; a second opening in the top of A admits the tube L, which is the commencement of the air supply which passes through the bent tube L to the valve flask V, and air box W K, to the aquarium D; a third opening admits the open tube St.

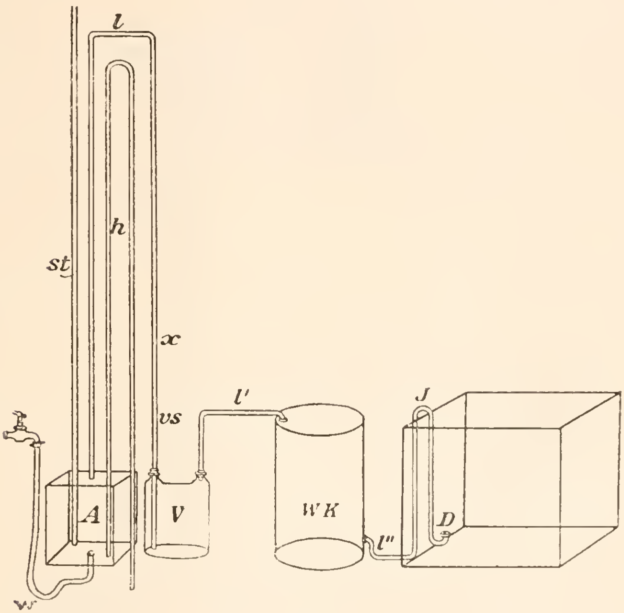

FIG. 15.

When a constant stream of water passes into A the bottom of the vessel will soon be covered, and when the lower openings of the tubes H and St are closed then the connection of the inside of A and the air present in the air supply tube with the outside atmosphere will be broken; water now begins to rise in the siphon tube H and in the tube St, and continues to do so until the pressure is sufficiently great to overcome the resistance at the outlet nozzle in D, and at this moment ventilation commences. When the cistern A is full the columns of water in the tubes St and H rise until the liquid tips over the bend of H and brings into action the free arm of the siphon, whereby the vessel A is quickly emptied, when it will be filled with air sucked in by the tube St; the process is then repeated. It is necessary that the upper end of St and

* SB. Gesell. Naturf. Freunde, 1906 (Feb.) p. 66.

the highest point of L should be higher than the bend of the siphon tube H.

Aeration of Aquaria.*—O. Thilo describes the following apparatus for ventilating aquaria (fig. 16). A piece of rubber tubing of 2–3 mm. bore and 30 cm. long is drawn through the tube of a glass funnel so as to leave the upper portion of the rubber tubing sticking out of the funnel tube; into the lower end of the tubing is pushed a piece of

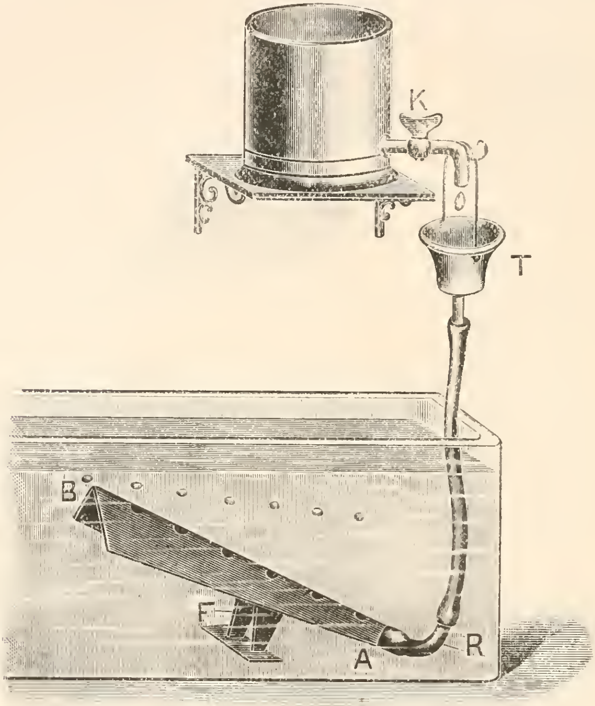

Fig. 16.

metal tubing, and on to the free end of this tube is fixed a rubber tubing of about 4–5 mm. bore, and the end of this rubber tube is pulled over another metal tube R (fig. 17). The funnel is suspended under a tap, and water is allowed to drip into it; the air in the tubing will be driven into the aquarium, on the floor of which rests the tube R. The author finds it is necessary that for a depth of 50 cm. of water in the aquarium, the funnel should be at least 150 cm. above the floor of the aquarium. It is also useful to place a perforated shield over the tube R in order to

* SB. Gesell. Naturf. Freunde, 1906 (May) p. 139.

distribute the air after it escapes; and this is also facilitated by tilting the end of the tube R to 23° from the horizontal.

Schweizer's Reagent.*—G. B. de Toni has discovered a way of making this reagent, which obviates the tiresome task of repeatedly washing the copper hydroxide, and thus simplifies the preparation: 10 grm. of pure crystallised sulphate of copper are reduced to a fine powder in a mortar. While grinding, 2 grm. of powdered caustic soda are added a little at a time: from time to time a few drops of distilled water are allowed to fall on the mixture. To the resulting greenish

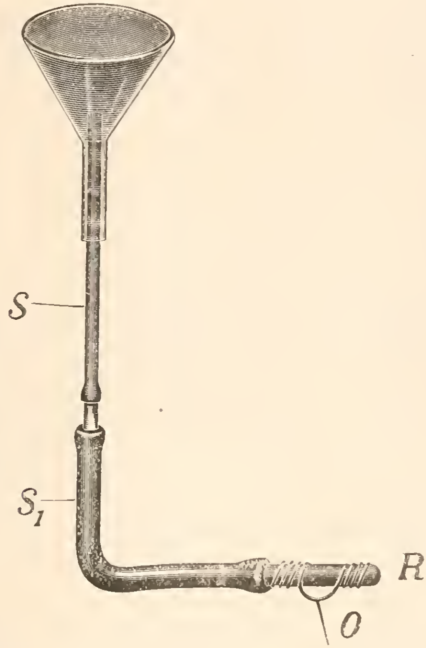

Fig. 17.

mass are added gradually, and stirring the while, 25–40 c.cm. of strong ammonia (26–29 Baumé), which dissolves the hydroxide of copper formed by the action of the soda on the copper sulphate. The mixture is then filtered through glass wool: the filtrate of a dark blue colour has all the properties of Schweizer's reagent. Cotton, when treated with this fluid, is completely dissolved, and when the cupro-ammoniacal solution is treated with water, or better with acidulated water, cellulose is precipitated in fine white flakes.

Another method of preparing the reagent is given by the author: 10 grm. of copper sulphate are dissolved in 200 c.cm. of distilled water and mixed with 7 grm. of barium hydroxide dissolved in 200 c.cm. of water. The precipitate which forms is filtered off on glass wool, and

* Atti R. Istit. Veneto, lxv. (1905–6) pp. 593–6.

then 50 c.cm. of strong ammonia poured over it. The blue liquid which passes through is poured back again several times over the precipitate in order to obtain all the copper hydroxide and leave only the insoluble barium sulphate. The fluid thus obtained is found to have a strong solvent action on cotton.

Apparatus for Observing the Suction of Insects.*—G. Zirolla has devised the following apparatus (fig. 18), by means of which an isolated

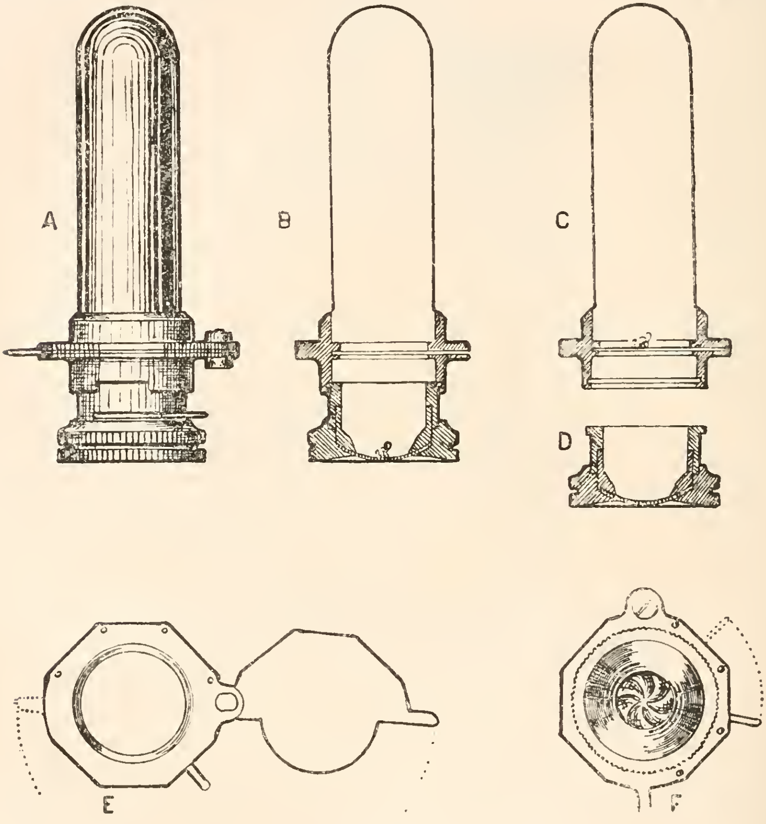

Fig. 18.

insect can be retained whilst it sucks blood from a healthy or infected man or animal. It consists of a small glass tube C, which is inclosed in a nickel vessel provided with an easily movable disk, by which the tube can be closed or opened. This tube is hitched to a nickel stand D, which at its base has an iris-diaphragm with a convex lower surface.

* Centralbl. Bakt., 1te Abt. Orig., xlviii. (1908) p. 173 (1 fig.).

This stand is placed on the body of the animal whose blood the insect in the tube C is required to suck; the disk in the tube is removed, and the diaphragm of D is opened, and the insect is thus brought in contact with the skin. When suction has taken place the diaphragm is slowly closed, whereby the insect is drawn back again into the tube; the apparatus is now removed and inverted, so as to allow the insect to fall to the bottom of the tube C, which is then closed again by the metal disk, and removed from the stand. In this way a number of insects may be successively used and preserved for further observation or experiment.

Small Bacterial Grinder.*—B. White describes a small mill (fig. 19) for grinding dried bacterial cultures. It consists of a thick glass flask with a ground stopper, holding 20–30 smooth agate marbles, about 1·5 cm.

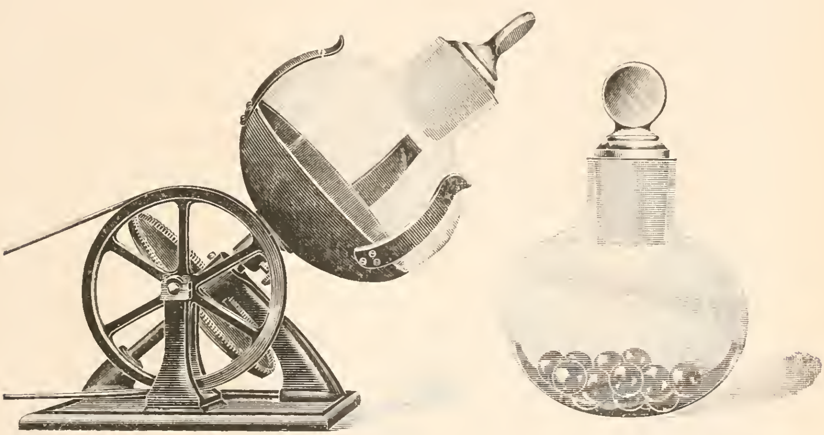

Fig. 19.

diameter. The flask is fixed to a metal holder, fitted with an axis, which by a simple mechanism can be slowly rotated. The apparatus is readily sterilised, and very fine state of powder can be obtained.

After ten hours a dried culture of *Bacillus typhosus* exhibited no bacillary bodies.

Methods of Textile Chemistry.†—This work, by F. Dannerth, though it does not directly appeal to the microscopist, will be found very useful by anyone interested in textile fabrics, owing to a very excellent glossary of trade terms.

* Centralbl. Bakt., 1te Abt. Orig., xlviii. (1908) p. 254.

† New York: John Wiley and Sons; London: Chapman and Hall, 1908, viii. and 164 pp.

Metallography, etc.

Quenching Velocities.*—C. Benedicks has carried out a lengthy and painstaking investigation on the cooling power of liquids, on quenching velocities, and on the constituents troostite and austenite. From the results given by two different methods, in which the temperature of a body heated by electrical energy and cooled by a flowing liquid was measured, it is concluded that, as Le Chatelier had found by another method, mercury is much inferior to water in cooling power, that the main factor in the cooling power of a liquid is its latent heat of vapour; specific heat has a secondary influence; conductivity for heat and viscosity may probably be neglected. Experiments in which photographic time-temperature curves of small pieces of steel quenched in water were taken, demonstrated that the time occupied in cooling through a given range (700°–100° C.) is directly proportional to the mass, but almost independent of the surface area of the specimen. Speed of cooling is increased by raising the temperature from which the sample is quenched. Troostite is held to be a solid colloid solution of cementite in iron, and "osmondite" is a state with a maximum content of troostite. For the detection of austenite, a new etching reagent, 5 p.c. alcoholic solution of metanitrobenzolsulphonic acid was found to be useful. The preservation of austenite in carbon steel requires a high mechanical pressure.

Iron-Carbon Equilibrium.†—G. B. Upton proposes a greatly modified iron-carbon diagram, based upon the experimental results obtained by Carpenter, Wüst, Goerens, and others. The hypothesis of iron-graphite as the stable system with iron-ironcarbide metastable, is considered to be unnecessary. The phases crystallising from the melt are solid solution and graphite, forming a eutectic at 1145° C. of 4·3 p.c. carbon. At 1095° C. the inversion γ + graphite to $\gamma + Fe_6C$, or Fe_6C + graphite occurs. At 800° C., Fe_6C breaks up into $Fe_3C + \gamma$; and at 615° C., Fe_3C decomposes into $Fe_2C + Fe$. The two new phases Fe_6C and Fe_2C are introduced to account for the thermal critical points found by Carpenter and Keeling in the neighbourhood of 800° and 600° C. The existence of these compounds appears to be supported by the work of Campbell and others on the chemical constitution of cast irons.

The author deals in a very thorough manner with the various phenomena (such as formation of temper-carbon) exhibited by the cast irons, and accounts for all of them in his equilibrium diagram, which, however, appears likely to meet with much well-founded criticism.

Copper and Copper Alloys.‡—J. T. Milton discusses numerous cases of abnormal behaviour, and indicates directions in which investigation should be pursued. The effect of hot and cold work, and of annealing, is imperfectly understood. The influence of heat-treatment on the

* Journ. Iron and Steel Inst., lxxvii. (1908) pp. 153–257 (51 figs.).

† Journ. Phys. Chem., xii. (1908) pp. 507–49 (13 figs.).

‡ Ironmongers' Chronicle (Special Report Number, Institute of Metals, Birmingham Meeting) lxi. (1908) pp. 11–15.

copper-zinc alloys is discussed. The author suggests that the effect of high casting temperature on copper-tin and other alloys is due to slower rate of solidification caused by the greater heating of the mould.

Mechanism of Annealing.* — G. D. Bengough and O. F. Hudson discuss the annealing process in copper alloys. In the case of single phase alloys or pure metals the effect of annealing seems to be essentially the conversion of Beilby's hard A phase into the C or crystalline phase. In more complex alloys, such as Muntz metal, annealing may produce a change of constitution. The annealing temperature of cartridge brass may be between 550° and 730° C., preferably 600°–650° C. The Microscope affords a ready means of controlling the annealing process.

Phosphor Bronze.†—A. Philip has collected a large number of chemical analyses and mechanical tests of phosphor bronze, and from them deduces the following as a suitable specification :—copper 90–92, tin 7·4–9·7, phosphorus 0·3–0·6 p.c. The author prefers to examine micro-sections polished but not etched. A grey network is probably Cu_3P. The presence of this network of hard copper phosphide in a matrix of softer copper-tin alloy renders the metal suitable for bearings.

Metallographic Investigation of Alloys.‡—W. Rosenhain discusses metallographic methods, dealing chiefly with those in which there is considerable divergence in the practice of different investigators. The necessity for using pure materials, for checking by actual analysis the composition of each alloy prepared, for using reasonably large quantities of metal in the thermal investigations, for accuracy of temperature measurement (by a potentiometer method when thermocouples are used), and for employing slow rates of cooling, is emphasized. The paper contains much criticism of the methods employed in Tammann's laboratory at Göttingen.

Intermetallic Compounds.§ — C. H. Desch gives an account of criteria for the existence of compounds. In binary metallic systems the methods available for the establishment of the existence and formulæ of compounds are :—1. Thermal analysis. 2. Microscopic examination. 3. Determination of electromotive force between an alloy and one of its component metals. 4. Chemical examination of residues (apt to give misleading results). 5. Measurements of (*a*) hardness, (*b*) density, (*c*) electrical conductivity. 6. Determination of heat of formation (an untrustworthy method). The combination of thermal and microscopical examination offers the most certain means of detecting compounds, electrical conductivity probably ranking next in importance. The author gives a list of well established compounds.

Structure of a Brittle Steel Sheet.‖—A. Sauveur has examined a steel sheet, carbon 0·05 p.c., exhibiting brittleness of the kind described by

* Ironmonger's Chronicle, lxi. (1908) pp. 5–20.
† Tom. cit., pp. 25–30. ‡ Tom. cit., pp. 30–40 (5 figs.).
§ Tom. cit., pp. 40–3 (5 figs.).
‖ Electrochem. and Met. Industry, vi. (1908) p. 271 (3 figs.).

Stead, probably the result of prolonged heating between 600° and 700° C. In micro-sections taken from a strip annealed at 835° C., thick bands were observed in the ferrite grains. The bands in any one grain were parallel, and appeared to have been attacked by the etching solution more strongly than the remainder of the grain.

Magnetic Changes in Steel.*—H. M. Boylston describes a laboratory experiment for illustrating the changes in magnetic properties occurring at the thermal critical points in steel. A drilled test-piece, within which is the hot junction of a thermo-couple, is supported just below an electromagnet, and is heated by blast lamps. The critical point is indicated by the test-piece beginning or ceasing to be attracted by the magnet, on cooling or heating.

Hard Spots in Steel Castings.†—A. P. Scott found that a hard spot in a roll casting consisted of an envelope of metal containing 12 p.c. manganese, 1·8 p.c. carbon, sharply differentiated from the steel and surrounding a cavity. Manganese had been added to the molten steel in the ladle only in the form of 80 p.c. ferromanganese. From the results of a number of experiments, in which molten steel was poured into small moulds containing small pyramids of ferromanganese, the author concludes that ferromanganese, when added to molten steel, first melts and then gradually absorbs iron, and probably gas also, from the surrounding metal. Complete diffusion does not take place till the liquid manganese alloy has been very considerably diluted. Solidification of a globule of the manganese alloy results in the formation of a hard spot.

Methods of obtaining Cooling Curves ‡—G. K. Burgess gives an outline of the various methods which have been developed for obtaining cooling curves, and briefly describes the apparatus employed. Only those methods of measuring temperature which depend on the use of thermocouples of the platinum metals are considered. An analytical discussion concludes the paper, and leads to the same result as the examination of the experimental methods: that the most certain and complete data may be obtained by combining temperature-time observations with those given by the differential method.

Recalescence Curves.§—W. Rosenhain discusses the methods of observing recalescence phenomena, and gives examples of heating and cooling curves obtained by the "time-temperature" and the "differential" methods. The "inverse-rate" and "derived differential" methods of plotting are explained. The author considers that the differential method of obtaining cooling curves is eminently satisfactory, and has important practical advantages over the "inverse-rate" method. The critical point at about 600° C., found by Roberts-Austen in iron, and by Carpenter and Keeling in iron-carbon alloys, is attributed to the presence of crystalline silica in the furnace walls. The author has found a recalescence in crystalline silica at about 580° C.

* Electrochem. and Met. Industrry, pp. 273–4 (2 figs.).
† Tom. cit., pp. 281–6, 323–6 (11 figs.).
‡ Tom. cit., pp. 366–71, 403–5 (11 figs.).
§ Proc. Phys. Soc., xxi. (1908) pp. 180–208 (18 figs.).

Transparent Metallic Films.*—T. Turner finds that thin films of gold, silver, or copper, heated in air between glass slips, become transparent at temperatures below 550° C. In the case of gold and silver, microscopic examination proves that the apparent transparency is due to destruction of continuity of the film, the metal aggregating when heated into separate granular masses. Under similar conditions copper oxidises, forming a continuous transparent film, bright green at first, then gradually darkening to deep brown. The discovery of a transparent stage in the oxidation of copper supports the view that the spectrum colours, which appear on the surface of certain metals by oxidation, are due to the formation of a transparent film.

Structure of Eutectics.†—As a preliminary to the study of a pure eutectic alloy, W. Rosenhain and P. A. Tucker have re-determined the equilibrium diagram of the lead-tin system.‡ The eutectic point is placed at a concentration of 63 p.c. tin. Transformations of the lead-rich alloys, occurring in the solid state, are regarded as the separation of tin from the solid solution of tin in lead, which changes from the β to the α state. The eutectic consists of grains, in each of which there is a systematic orientation of the laminations produced by layers of the two constituents. The authors take the view that these grains are true spherulitic crystals.

Partition of Silver between Zinc and Lead.§—G. N. Potdar has investigated the constancy of the partition coefficient of silver between liquid zinc and liquid lead. Weighed quantities of the three metals were maintained at 540° C. for several hours, the mass was allowed to solidify, and the percentage of silver determined in each of the two layers. The separation of the lighter and heavier layers was not quite perfect: this caused discrepancies in the results. The author concludes that the coefficient is constant for the more dilute solutions, and is about 300. The partition coefficient of silver between solid zinc and liquid lead (of importance in the Parkes process), is much higher.

Troostite.‖—C. Benedicks defends the appellation "colloidal solution" as applied to troostite, on the ground that dispersed systems containing ultramicroscopic particles of metals are universally admitted to be colloidal solutions. H. le Chatelier considers that the expression "colloidal solution" must fall out of use, since the condition indicated is not one of solution in any true sense.

* Proc. Roy. Soc., Series A, lxxxi. (1908) pp. 301–10 (9 figs.).
† Tom cit., pp. 331–4 (1 fig.).
‡ See this Journal, 1908, p. 523.
§ Journ. Coll. of Sci. Tokyo, Japan, xxv. (1908) Art. 9 (4 figs.).
‖ Rev. Métallurgie, v. (1908) pp. 878–9.

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 16TH OF DECEMBER, 1908, AT 20 HANOVER SQUARE, W., CONRAD BECK, ESQ., VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of November 18, 1908, were read and confirmed, and were signed by the Chairman.

The List of Donations to the Society, exclusive of exchanges and reprints, received since the last Meeting, was read, and the thanks of the Society were voted to the Donors:—

	From
Dannerth, Frederic, The Methods of Textile Chemistry. (New York and London, 1908)	*The Publishers.*
Twelve Slides of Foraminifera from Soundings off the Coast of Somaliland	*Mr. Ernest Heath.*

Mr. J. E. Stead, F.R.S., read the following papers:—(1) "On a Workshop Microscope for the Examination of Opaque Objects"; (2) "On a Simple Method of Illuminating Opaque Objects"—specimens of the Microscopes and of the electric light fixed to the object-glasses, with portable battery attached, being exhibited in illustration. He also described and illustrated some simple methods of mounting irregularly-shaped pieces of metal, one side of which had been faced for microscopical examination.

Mr. Rosenhain said that it had given him great pleasure to see this very ingenious form of Microscope, which he thought was one which would meet a great want in the workshops for which it was intended. The only danger was, however, that some manufacturers might use it under the impression that they could get the best possible results from it, and would therefore neglect the more important instruments and apparatus specially constructed to obtain them. In the ordinary workshop they could only look at the surface of things, and as a rule this was not sufficient; to find out what was the matter with a bar of metal they must cut it in half and examine the section—so that for this reason he imagined that this Microscope would have a somewhat limited use. As regarded the illumination being placed above the objective, this was of course a very old method, but he thought it would be better to cut off the unsilvered half of the thin cover-glass, as this only served to obstruct a portion of the light. The pill-box arrangement was a very good method of mounting specimens for examination, but it involved using the Microscope in a vertical position, and this was all right for a few minutes; to have to work by the hour over an instrument so placed would become very distressing. It was a very pretty way of mounting and keeping the specimens; but metals such as iron and steel were very apt to rust on the polished surface, and so become spoilt, and he thought this method of keeping them would not obviate this risk, so that it would be necessary to keep them in a desiccator to prevent rusting, unless the surface was varnished, which would necessitate cleaning off when it was desired to examine them. He wished to express his interest in and appreciation of the apparatus which Mr. Stead had brought before the Society, and to thank him for having done so.

Mr. J. W. Gordon said he had been extremely interested in the subject of this paper, but with regard to one point mentioned by Mr. Rosenhain, he thought they need not be dependent upon the cardboard-box maker for a special shape to enable the Microscope to be used in an inclined position, because a little seccotine would stick the pill-box to an ordinary Microscope slip, which could be held in position by the clips on the stage, and would enable the instrument to be used at any angle. He thought the method of using a silvered mirror covering half the aperture would result incidentally in producing oblique illumination; and with regard to the method proposed by Mr. Stead of producing oblique lighting, namely, by exposing the lamp without the mirror, it appeared to him that this would limit the oblique lighting to one particular angle. For that reason he wished to suggest for Mr. Stead's consideration whether it would not be better to reflect the lamp light by means of a small mirror which could be moved in any direction required, and so throw the light under any desired angle upon the object. He desired to associate himself with the thanks to the author of the paper to which Mr. Rosenhain had given expression.

Mr. Stead, in reply, said he thought the result of using this Microscope by manufacturers was likely to be the opposite of that feared by Mr. Rosenhain: for when they began to appreciate elementary things, they would not be likely to remain long contented with them, but would want to possess what would afford them still greater advantages—an instance of this had, in fact, only lately occurred. As regarded cut sections of metal, such as steel shafts, etc., after they had been turned up and polished in the machine shops they were really cut sections, and the structure of the metal could be examined nearly as well with the aid of the portable Microscope as on sections cut out of them and brought into the laboratory for examination in the usual way. Of course they could not destroy shafts by cutting such pieces from the finished work. Unfortunately, iron and steel did rust if exposed to damp atmosphere, but after examining them, a drop of suitable varnish on the surface protected the polished and etched surfaces. If the sections were properly prepared, and heated to about 100° C., and then were placed into tubes and packed close with dry cotton-wool, rusting was prevented, and this alternative method was most useful. Varnish, however, was usually quite sufficient for the purpose, but in course of time the surfaces under the varnish sometimes became dull, but not rusty. In such cases the varnish could be removed by a suitable solvent, and the surfaces re-polished and etched. As regarded oblique illumination, he intended to improve the present design by placing a concave mirror not opposite to but behind the lamp, so as to obtain more light on the object. The mirror at 45° placed below the object-glass was simply a plain cover-glass not silvered, and this had been found to be quite sufficient for low-power magnification, but did not give such perfect illumination as the silvered glass placed half through the objective at an angle of 45°. As stated previously, the novel and useful departure in this class of Microscope was the arrangement in which the electric illumination was fixed to the object-glass itself.

The Chairman said it was not necessary, after the appreciative way in which Mr. Stead's paper had been received, to pass any formal vote of thanks. The Society was indebted to him not only for his paper, but for most interesting demonstrations in former times on the methods of preparing and examining metals under the Microscope, the importance of which was becoming more and more fully recognised. Quite recently he met with a notable instance, showing the value of microscopical examination. A large manufacturing firm found that the metal they were using was splitting during the process of manufacture. On subjecting it to chemical examination, they found that the ingredients were pure and the alloy was correct, so twenty minutes were spent in cutting and polishing a specimen and examining it under the Microscope, with the result that the trouble was at once located. Investigation showed that a workman in one department had been annealing the metal badly, so that another man should get into trouble when it came into his hands for manufacture. This was only one illustration of the value of this method of testing metals, and no one had been more prominent in furthering this kind of research than Mr. Stead.

The Rev. Eustace Tozer read a paper on "Mounting Rotifers and *Protista* in Canada Balsam," which he illustrated by a number of specimens exhibited under Microscopes in the room, including *Brachionus*, *Floscularia*, *Hydatina*, *Œcistes*, *Pterodina*, *Euglena*, ciliated embryo of *Membranipora pilosa*, *Polytoma uvella*, etc.

Mr. Charles S. Bright suggested that instead of oil of cloves, cajuput oil should be used, as being less liable to oxidise, and also much more absorbent of alcohol, one volume of cajuput oil absorbing from seven to nine times as much alcohol as the same volume of oil of cloves would do. Oil of cajuput has a greater affinity for Canada balsam, belonging chemically to the same class, Canada balsam being of the terebene or turpentine series, which includes cajuput, lemon, orange, citron, cedrat, etc.

Mr. Rousselet said he noticed Mr. Tozer spoke of using osmic acid first, but he had always found it necessary to narcotise the Rotifers with cocaine first, otherwise they would at once shut up. He had prepared a few notes on the subject of mounting Rotifera, which he proceeded to read as follows :—

The difficulty of mounting Rotifera in media appreciably denser than water, such as glycerin or Canada balsam, is well known to all who have made the attempt. This difficulty arises from the fact that the body of a Rotifer is a closed vesicle containing a perivisceral fluid of about the same density as the water in which the creature lives. The integument is a thin membrane, which allows an exchange of fluid only by osmosis. When a Rotifer—which has been duly narcotised, fixed, and killed, fully extended with osmic acid or other fixing agent—is placed in say, a 5 p.c. watery solution of glycerin (having a specific gravity of about 1·017), the fluid within the body-cavity will pass out quicker than the denser outer fluid can flow in, and the result is a shrinkage and often complete collapse of the Rotifer. By beginning with a very weak solution of glycerin and increasing this ½ p.c. at a time, I have with infinite trouble succeeded in about three weeks in mounting some *Euchlanis* and other Rotifers in pure glycerin, but the advantages gained were hardly worth the expenditure of time involved. When Rotifers are to be mounted in balsam, the trouble begins with the alcohol; then there is the passage through oil and balsam, each denser than the preceding fluid. The method is therefore a work of very considerable difficulty, skill, and patience, and Mr. Tozer must be congratulated on accomplishing so much. A minor drawback is the necessity of deeply staining the Rotifers, otherwise the balsam will render their tissues and organs so transparent as to be scarcely visible.

The mounting of Infusoria in Canada balsam does not present the same difficulties, because Infusoria have no proper body-cavity, and their bodies consist wholly of protoplasm, which can be fixed and hardened by well-known reagents to any desired degree.

Of previous successful attempts to mount Rotifera in balsam, may be mentioned that of N. de Zograf, who fixed the animals with osmic acid and raw wood vinegar.*

Quite recently I received a few *Eosphora* quite well mounted in balsam from a correspondent in Germany, who fixed the Rotifers with mixtures of picric acid and acetic acid, and picric acid and chromic acid, and, after passing through alcohol, adding graduated mixtures of absolute alcohol and clove oil, and finally balsam.

Of the advantage, for permanent keeping, of mounting Rotifers in balsam there can be no doubt, but it seems evident that all the methods of doing so will always be very tedious, and involve much expenditure of time. The Society, however, must be grateful to Mr. Tozer for bringing this subject before them, and describing his method of procedure and exhibiting the results he has achieved.

Mr. Wesché said that he had been rather surprised, on examining Mr. Tozer's preparations, to see how good the results were, although he was still of the opinion that the only really good Rotifer was a live Rotifer. But whatever the process, a permanent record was valuable, and even necessary, to enable the naturalist to differentiate between the species of difficult genera. As an illustration of the permanence of such mounts, he had some slides of the aquatic larvæ and pupæ of gnats (*Culex*) which had been mounted in Canada balsam forty years ago. One of these slides had been accidentally damaged, and the balsam in the centre was still in a fluid state.

The Rev. Eustace Tozer said there was a reason for using oil of

* Described by him in Comptes Rendus, cxxiv. (1897) pp. 245–6. For extract, see this Journal, 1897, p. 173.

cloves by preference, as it did not evaporate and allowed manipulation of the specimens. He had said very little as to the method of expanding Rotifers, as he thought most people knew all about how that was done ; and as regarded the success of his method, there were the slides to witness for themselves, and he claimed that they showed the objects without shrinkage, and they had been seen and commended by some of the most eminent scientists in Europe. Mr. Rousselet was a specialist in water-mounting, a process which had nothing against it except that the results might not be as safe, owing to the risk of leakage.

On the motion of the Chairman, a vote of thanks was unanimously passed to the reader of the paper, and those who had spoken on the subject.

It was announced on behalf of the Council that they had nominated the following Fellows to serve as Officers and Council during the ensuing year :—

President—Sir E. Ray Lankester, K.C.B., F.R.S., etc.

Vice-Presidents—Mr. Cheshire, Rev. Dr. Dallinger, Sir Ford North, and Mr. Spitta.

Treasurer—Mr. W. E. Baxter.

Secretaries—Mr. J. W. Gordon and Dr. Hebb.

Ordinary Members of Council—Messrs. F. W. Watson Baker, Disney, Eyre, Heron-Allen, Plimmer, Powell, Price-Jones, Radley, Rheinberg, Rousselet, Scales, and Scourfield.

Auditor on behalf of the Council—Mr. D. J. Scourfield.

The Chairman having asked the Fellows present to nominate an Auditor on behalf of the Society, Mr. C. L. Curties was proposed by Mr. Soar, and seconded by Mr. Taverner, and on his name being submitted to the Meeting he was declared to have been duly elected Auditor of the Society's accounts for the current year.

It was announced that the next Meeting of the Society being the Annual Meeting, the ballot would be taken for the election of Officers and Council for the ensuing year, and the President would deliver his Address, " On Seeds, with Special Reference to British Plants."

It was further announced that the rooms of the Society would be closed from December 24 to January 4.

New Fellows.—The following were balloted for and duly elected *Ordinary* Fellows of the Society :—Messrs. Theodore Brooks and W. F. Herzberg.

The following Objects, Instruments, etc., were exhibited :—

Mr. J. E. Stead : — The following objects under examples of the "Workshop" Microscope with appliances for illuminating opaque objects and portable electric light—1. A section of Cleveland pig-iron containing $1\frac{1}{2}$ p.c. phosphorus, strongly etched with 10 p.c. nitric acid in water ; the phosphorus-iron eutectic remained brilliantly white on a dark ground. 2. An alloy of iron-phosphorus and carbon polished and "heat-tinted": the carbide of iron was coloured red, the phosphorus-iron eutectic purple. 3. Cemented bar of steel, containing 1·25 p.c. carbon, etched with picric acid in alcohol: the carbide appeared white on a brown ground. 4. Cemented bar, same as No. 3, polished and "heat-tinted": the carbide of iron appeared red on a light ground.

Rev. Eustace Tozer:—The following objects, mounted in balsam, in illustration of his paper:—*Brachionus pala*, with sporozoa; *Floscularia*; *Hydatina senta*; *Œcistes stygis*; *Pterodina pala*; *Euglena*; ciliated embryo of *Membranipora pilosa*; *Polytoma uvella*; etc.

Mr. C. F. Rousselet:—*Notops brachionus*, mounted in formalin.

SPECIAL MEETING.

The Chairman declared the Meeting to be now made "Special," pursuant to notice given at the last Meeting on the requisition of 11 Fellows of the Society.

Mr. D. J. Scourfield then moved the resolution of which notice had been given—to the effect that the By-laws of the Society be altered as might be found necessary to admit women to the Meetings of the Society, and to remove any other restriction of privileges due to the distinction of sex.

Mr. Scourfield said that, in moving the resolution, he realised that it was a very important one for the Society, and one therefore to be carefully considered from all points of view. He frankly admitted that it would not be sufficient in such a case to be content with a mere majority vote if that vote were obtained in the face of strong opposition, even though the opposition were based upon what appeared to those in favour of the resolution to be misapprehension. In a Society such as the Royal Microscopical Society, depending for its very existence upon voluntary co-operation, he thought that to carry out a radical change such as that now proposed, there should be something approaching mutual consent, and this could only be obtained by putting the good of the Society before every other consideration. Believing as he did that the admission of women to the full privileges of Fellowship would be for the benefit of the Society, he would deal with the matter simply from that point of view by indicating some of the advantages which might be anticipated to follow from the proposed alteration of the by-laws.

In the first place, he thought that the carrying out to its logical conclusion of the policy introduced many years ago of allowing women to become Fellows would redound to the credit of the Society, by removing the reproach that women were not being treated fairly in this matter. The Society posed before the world as one granting Fellowship without distinction of sex, and yet said that lady Fellows must not come to the meetings or vote, and the real trouble was that this had been going on for a long time without any serious effort being made to see if matters could not be put right. Was it to be wondered at that people smiled when they were told of the conditions of Fellowship for women? He thought that the Society had not only lost many women, but men also, who would under more logical conditions have become Fellows. The Society could not go on indefinitely having things both ways. It might do so for a time, but it would bring discredit in the long run, unless it could be made quite apparent that there were no possible means of putting things on a more satisfactory basis.

Secondly, if the Society wanted to maintain its position as a first-class scientific Society, it was bound sooner or later to follow the example of the Linnean, Zoological, and other similar Societies, which had already adopted the principle of the admission of women to the full privileges of Fellowship. It was so evidently to the advantage of the Society to attract as much ability as it could, whether the possessors were men or women, that it seemed quite clear that the Society should do all in its power to make the privileges of Fellowship as many as possible for both men and women. The tendency for women to possess knowledge in microscopical matters was growing. If women were kept out much longer, as they certainly were being kept out by the present conditions, the Society would have to face the certainty of taking a much lower position among scientific societies than it had hitherto done.

Lastly, the admission of women to full privileges would undoubtedly increase the membership of the Society. How could it be expected that women would join in any numbers when the conditions were so unequal for men and women? It was a wonder that any women had joined under such conditions, and the fact that some had so joined was, he thought, sufficient to show that others would be glad to avail themselves of the benefits of belonging to the Society if they could do so on equal terms with men. That a large number of women would ever be attracted to the Society was of course unlikely, but the present number of lady Fellows might very well be increased four- or five-fold, and that would mean eventually an addition of thirty or forty to the Society's membership.

In concluding his remarks in favour of the resolution, Mr. Scourfield said he had not attempted to answer in advance any objections which might be urged to the admission of women to the meetings, but he was most anxious to hear and consider everything that could be brought forward by those opposed to the resolution.

Mr. Frederic J. Cheshire, in seconding the motion, said that there were three important points that should be constantly borne in mind by those taking part in the discussion about to take place. In the first place, it was important to remember that this was not a motion made for the purpose of admitting women as Fellows of the Society—that had already been done—but simply for removing certain disabilities under which women Fellows laboured. Secondly, the present position of the Society as regards the question at issue was an untenable one. To require women, as was done, to pay the same entrance and subscription fees as men, and then to refuse them practically all the benefits of the Society, was a procedure which could only be characterised as absolutely grotesque in its unfairness. Thirdly, and lastly, it should be recognised that the Society is not being asked to take a leap in the dark. Women have already been admitted to the full benefits of several learned societies, with--so far as he, the speaker, knew or had been able to learn—nothing but the happiest results.

The Chairman said that, before they went further, he thought the Society would be glad to know the opinion of the Council on the matter, and consequently he stated that at the Meeting of the Council it had been very carefully considered, and they had passed a resolution which it was proposed to submit to the Meeting for approval—by which they declared that the time had arrived when this question must be seriously considered, and they recommended that a special committee be appointed to go into the matter, and to draw up a report as the result of their deliberations, such report to be afterwards submitted to a special Meeting of the Society to be called by the Council, for their acceptance or otherwise.

Mr. J. W. Gordon thought that in the present circumstances it would be extremely inconvenient to discuss this question at that Meeting, before it had been more completely considered in all its bearings. The question had been very fairly stated on one side by Mr. Scourfield, but, although he had given it his best attention, he was not himself in favour of the proposal. At the same time, he was in agreement with Mr. Scourfield that it was a question which should be very carefully considered, especially as there were some serious difficulties of a practical nature to be faced in carrying out the proposal. 1. Assuming that they had succeeded in attracting a number of ladies to the Society, a serious question presented itself as to providing them with proper cloak-room accommodation. There were no such conveniences available in this building, and to provide them would, if permission were obtained to do so, involve a considerable outlay. 2. The introduction of ladies to their Meetings, which took place in the evening, would be very likely to lead to what might be called the evening-dress habit ; and if this became general it would probably affect the attendance at their Meetings, by involving inconvenience to many Fellows of the Society. He himself belonged to the Royal Institution, where ladies attend the evening Meetings in considerable numbers, and at which consequently the wearing of evening dress had become customary. He personally found that by reason of the evening-dress habit he did not attend more than three or four of these Meetings in the season, because he was generally too busy, or, as some friend had put it, too indolent, to get into evening dress for the purpose, and then get back into working dress when he got home in order to resume an interrupted task at the lathe or bench. He wished to suggest that this was a matter for serious consideration. 3. Communications have reached the Officers of the Society which showed that there were Fellows who took a very strong adverse view of the proposal, and it would obviously be unwise to proceed with it in the face of any considerable opposition, and possibly provoke, what had, in fact, been threatened, a secession from the ranks of the Society. For these reasons he submitted that it would be very desirable, before coming to any definite decision, that the opinion of the Fellows generally should be ascertained, and the subject in all its aspects investigated by a committee. He therefore moved that the suggestion of the Council be adopted, and that a small committee be appointed to consider the matter fully and to report the result to the Society, and submitted an amendment to that effect.

Mr. W. T. Webster thought that some of the older Fellows of the Society should also be appointed to serve on this Committee.

Dr. Price-Jones seconded Mr. Gordon's proposal that the matter should be referred to a committee appointed for the purpose.

The Chairman said they had received a letter from Lord Avebury approving of the proposal to admit ladies, which letter he read to the Meeting :—"As regards the admission of ladies, may I say that at the Anthropological Institute and the Linnean Society we have found no inconvenience, but, on the contrary, an advantage ; and from a practical point of view, a substantial addition to our funds."

Mr. Heron-Allen thought the extremely clear setting forth of the case by Mr. Scourfield seemed to comprise everything to be said in its favour ; but whilst some persons might think Mr. Scourfield going too fast, others might think that Mr. Gordon was going too slow ; but the questions was certainly a very wide one. Mr. Gordon's proposal seemed, however, to make rather a Star Chamber matter of it, and if this committee was appointed it seemed to him that it should be wider than the narrow limits suggested by Mr. Gordon, and should be composed of persons of different opinions, who should be asked beforehand if they were in favour of the proposal or not, because if the committee consisted of persons who would all go one way, their recommendation would be a foregone conclusion. The objections put forward by Mr. Gordon did not seem to be practical ones ; the cloak-room difficulty would be solved by the non-attendance of those persons to whom it constituted a difficulty, and the question of evening dress was not likely to give trouble.

The Chairman hoped it would not be thought that by making this proposal the Council desired that the subject should not be discussed, as no doubt some Members had specially attended this Meeting with the intention of expressing their opinions.

Mr. Hopkinson said that he could answer the two objections to the admission of ladies to their Meetings which had been raised by Mr. Gordon. As regards cloak-room accommodation, the Council of the Selborne Society, on which were several ladies, met in this building, and no difficulty had arisen ; and as to evening dress, it was not worn at the Linnean, the Royal Meteorological, and other Societies which admitted ladies to their Meetings. At the Linnean Society ladies had to take off their hats, the Meeting room having a flat floor ; but this was not necessary at the Meetings of the Royal Meteorological Society, held in the lecture theatre of the Institution of Civil Engineers. At their previous Meeting he heard it objected that ladies would want to do all the talking, but in his experience with several scientific societies it was very rarely that a lady made a remark, but if one did speak it was audibly and to the point, which was more than could always be said of the men. Moreover, some of the best papers recently read at the Linnean and Geological Societies were by ladies. Since they were admitted into the Linnean Society, four years ago, with full privileges (one now being on the Council), about twelve per annum had been elected, and as nearly one-third had compounded, the addition to the funds of the Society must have already reached at least £1000. He thought that the Fellows generally would value any step which tended to add to their numbers, increase the attendance at their Meetings, and induce ladies to contribute papers; and he felt sure that the presence of ladies would make their Meeting brighter, and on their conclusion increase the pleasure of social intercourse. Mr. Hopkinson wished to be permitted to add, that although ladies have not yet the privilege of Fellowship of the Geological Society, they have lately been admitted to the Meetings, and invited to speak when a paper by a lady has been read.

Mr. Wesché said it was within their knowledge that some sort of canvass had been going on in connection with this matter, but, though the opposition to this motion seemed rather unreasonable, it came from Fellows of the Society whose feelings it was most repugnant to him to hurt, and he suggested that each Fellow should be circularised, so that they might get a distinct idea as to the wishes of the majority, and as to how large that majority was.

The Chairman said that there had been no official ballot taken on the question, but it was thought that this should be done, and that was one reason why a committee was suggested to deal with it. As regarded abstract justice, he did not see that this entered into the question, as it was quite competent for any number of persons to form a Society and to make what rules and conditions they pleased, and those who joined knew those conditions beforehand.

The Chairman was about to put Mr. Gordon's motion to the Meeting, when Mr. Marks interposed with a question as to why the matter could not be settled at once?

Mr. Freshwater said he should like to ask the Chairman, before the vote was taken, the following questions: Were not visitors present, and and if so, was it not usual for them to retire before a special Meeting began? He also asked, What was the qualification for voting?—was there not a rule that no person should be allowed to vote if his subscription was in arrear?

Mr. J. W. Gordon said he understood that the mover and seconder of the original motion had accepted the amended form suggested by the Council, which he had moved, and which therefore stood to be voted upon, the amendment by consent taking the place of the original motion. It was, of course, quite competent to anyone to move a further amendment, which would then have to be considered, but at present the reference of the whole subject to a committee for investigation and report was the only proposal before the Meeting.

Mr. Cheshire quite agreed that in a matter of this kind the greatest tact was necessary, and that it should not be decided hastily in the face of strong personal feelings. Under these circumstances, and in the best interests of the Society, he thought it very desirable that all the Fellows should be consulted, although if there was no such opposition there did not appear to be any reason for not deciding the matter by a vote at once.

The Chairman said that if anyone wished to move that the original resolution be put to the Meeting at once, it was quite within his rights to do so.

Mr. J. M. Allen said it was not a question for the Council, nor was it one for that Meeting, but for the Society *qua* Society, and therefore for all the Fellows ; and that he therefore thought that all the Fellows should be circularised, and the opinion of each and all ascertained.

Mr. Hopkinson said that in the case of the Geological Society, a poll having been demanded on the question of the admission of women, three points were submitted to the Fellows :—(1) Should women be admitted as Fellows with full privileges ; (2) should they be admitted as Associates with restricted privileges ; and (3) or not admitted at all. The result was that a large majority were in favour of their admission as Fellows. He thought that the committee should be more representative than the small one proposed, and that this would tend to inspire confidence in any decision arrived at.

Mr. Webster proposed that a circular inviting an expression of opinion should be sent to each Fellow of the Society.

Mr. J. M. Allen seconded this.

Mr. Cheshire, rising to a point of order, said he understood from the rules that this question could not be settled by a postal vote, but it must be done by vote at a Special Meeting called for the purpose.

Mr. J. W. Gordon said they wanted first to find out what arrangements it would be necessary to make, and whether they could be made, hence the necessity for a committee to go fully into the matter.

The Chairman inquired if it would meet the wishes of those present that the last proposal should be included in the resolution to be put to the Meeting.

Mr. J. M. Allen said he thought the Assistant Secretary should be instructed to send a circular to every Fellow.

Dr. Hebb thought this would put the matter off a very long time, as they had Fellows living in all parts of the world, for whose replies it would be necessary to wait.

A Fellow thought it probable that there might be some prejudice against such an alteration as was proposed, and, judging from Mr. Gordon's remarks, it appeared that this was so ; the committee would therefore have to ascertain to what extent it prevailed.

Mr. Scourfield was understood to agree to the proposal made, and to the necessity for circularising the Fellows in order to ascertain their feelings on the general question.

The Chairman said that, the original motion being withdrawn, he put the amendment to the Meeting, and declared it to be carried unanimously.

The following Fellows were then appointed Members of the special committee—Messrs. Conrad Beck, Cheshire, Hopkinson, Scourfield, and Spitta, the President, Lord Avebury, the Treasurer and the two Secretaries becoming ex-officio members, in accordance with the By-laws.

ANNIVERSARY MEETING

HELD ON THE 20TH OF JANUARY, 1909, AT 20 HANOVER SQUARE, W. THE RT. HON. LORD AVEBURY, F.R.S., ETC., PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of December 16, 1908, and of the Special Meeting of the same date, were read and confirmed, and were signed by the President.

Mr. J. E. Conrady and Mr. J. I. Pigg were appointed by the President as Scrutineers of the Ballot for Officers and Council for the ensuing year.

A Reflecting Microscope, made by Amici, presented to the Society by Mr. S. R. Roget, was exhibited, and was described by Mr. Rousselet, by whom it was regarded as a very valuable donation, as the Society had not hitherto possessed an instrument of this type. It was made in the early part of the last century on the principle of the Newtonian reflecting telescope in an attempt to overcome the chromatic errors in the Microscope—achromatic objectives not having at that time given satisfactory results.

The President said this was a most interesting addition to their collection of old Microscopes—for which the thanks of the Society were unanimously voted to Mr. Roget.

Dr. Hebb said he rose to propose a vote of thanks to Sir Frank Crisp and Mr. E. M. Nelson, who loaned several Microscopes to the Society in order that the collection shown at the Franco-British Exhibition might be rendered historically complete. He begged to move that the special thanks of the Society be given to those gentlemen for their kindness.

The motion having been put to the Meeting by the President, was unanimously carried.

Mr. Conrad Beck exhibited and described an instrument, invented by Dr. Leslie Buchanan, consisting of two small Microscopes with negative eye-pieces converged at an angle and used as a binocular instrument for the examination of the eyes of patients by oculists. The eye-pieces are prismatic and adjustable, the distance between the eyes is adjustable—when in use it was strapped upon the head of the operator, the eye-pieces being at a sufficient distance from his eyes to enable him to look down to select his instruments, whilst the working distance was about 3 in. and the magnifying power × 18.

Mr. F. Watson Baker (for Messrs. W. Watson and Sons, Ltd.), exhibited a new form of Portable Microscope, designed to be free from the complicated folding up and taking to pieces which is usually associated with this class of instrument. In this Microscope the legs alone fold backwards and the mirror stem is pushed upwards through a fitting in the stage. Provision is made, in the small leather case measuring $7\frac{1}{4}$ by $4\frac{1}{2}$ by $3\frac{1}{2}$ in., for the stand, four objectives, two eye-pieces, and other accessories.

He also exhibited a Student's Microscope of new design called the "Standard," the chief features of which were the new design of the foot and a fine-adjustment working by means of a milled head at the side of the limb, the movement being effected by a slightly coned pin bearing against a roller, each turn of the milled head raising or lowering the body $\frac{1}{250}$ of an inch.

Mr. F. Plaskitt exhibited some high power photomicrographs of *Podura* scales, taken to show their transverse markings, a short paper in description of this exhibit being read to the Meeting. The scales were mounted dry on the cover-glass and taken on an ordinary $\frac{1}{4}$-plate, being subsequently enlarged to 10 by 8 for better inspection. The transverse markings lie beneath the usual exclamation marks, undulating at varying depths from side to side.

The thanks of the Society were voted to these three gentlemen for their exhibits.

Attention was called to an exhibition by the Society under Microscopes in the room of a number of slides of Foraminifera dredged off the coast of Somaliland, presented by Mr. Heath at the last Meeting.

The Report of the Council for the year 1908 was then read to the Meeting by Dr. Hebb.

REPORT OF THE COUNCIL FOR 1908.

FELLOWS.

During the year 1908, 15 new Fellows have been elected and 3 re-instated; 11 have died, 14 have resigned, and 1 has been removed.

Eight of the deceased were Fellows for from 20 to 58 years.

Among the deaths the Council regrets to notice the names of two distinguished Fellows, viz. of Henry Clifton Sorby, F.R.S., a former President (of whom an obituary notice has already appeared in this Journal), and of Jean Alfred Nachet, the eminent French microscopist and optician, who presented to the Society one of its most valuable possessions.

The list of Fellows now contains 383 Ordinary, 1 Corresponding, 42 Honorary, and 79 Ex-Officio Fellows, being a total of 505.

FINANCE.

The income of the Society has not been diminished, and the subscriptions have been paid with the usual regularity, but the expenditure is still in excess of income. This can be best remedied by an increase in the number of Members. It is to be hoped that the efforts now being made to accomplish this desirable object will bear fruit, and early fruit; but the Council commends this matter to the special attention of the Fellows, as it is only by the exercise of individual influence that new Members can be recruited to the Society's ranks.

JOURNAL.

In the Transactions are recorded 21 original papers, a greater number than the Society has received for many years.

The obituary notices of Sorby and Wenham are of great interest and value.

The summary of current researches in Zoology, Botany, Microscopy, and Metallography, has maintained its previous high standard of excellence.

The extent and thoroughness of this branch of the Society's work is limited by pecuniary considerations, and with increased financial support the work could be made still fuller and more exhaustive than it is.

LIBRARY.

The Library has been maintained in as efficient a manner as the funds of the Society will allow. Some valuable additions have been received from various generous donors, both authors and publishers.

At the suggestion of a Fellow—who also offered a donation towards the object he had in view—a subscription list has been opened for providing the funds for printing a new Catalogue. It is to be hoped that the Fellows will liberally support this scheme, as an up-to-date record of the Society's belongings, viz. Books, Instruments, Apparatus, and Slides, is a desideratum.

INSTRUMENTS AND APPARATUS.

The Instruments and Apparatus in the Society's Collection continue to be in good condition.

During the past year the following additions have been made:—

January 15.—An Old Microscope, by Jones, successor of Adams. Presented by Mr. A. G. Michie, through Sir Frank Crisp.

April 16.—An Old Microscope, made by Shuttleworth about 1786. Presented by Mr. Wynne E. Baxter, Treasurer.

CABINET.

The following additions to the Slide Cabinet have been made during the past year:—a slide of *Protococcus nivalis*, presented by the Peary Arctic Club; 12 beautifully mounted slides of Foraminifera, from soundings off the coast of Somaliland, presented by Mr. Ernest Heath.

The Council desires to recall the occasion of the Society being invited to participate with other scientific and learned bodies in the celebration of the jubilee of the joint paper by Charles Robert Darwin and Alfred Russell Wallace by the Linnean Society, when it was represented by its President; and in this connection it is gratified to be able to announce that Lord Avebury has also consented to honour the Society by becoming its representative at the commemoration of the centenary of Darwin's birth, and the fiftieth anniversary of the publication of the Origin of Species, to be held at Cambridge in June next.

To another jubilee, that of the Museum of the University of Oxford, the Society was also bidden, when Mr. F. Shillington Scales represented it on the invitation of the Council.

In response to an invitation of the British Science Section of the Franco-British Exhibition, the Society lent a number (28) of instruments in the form of a collection illustrating the progress and development of the Microscope from the earliest times. Certain gaps were kindly supplied by Sir Frank Crisp and Mr. E. M. Nelson.

The selection, arrangement, and description of the instruments were carried out under the personal direction and supervision of Mr. C. F. Rousselet, to whom the thanks of the Society are in a special measure due in this connection.

The Society was awarded two Diplomas for Grand Prize for its exhibit.

Quite recently a revival of a former practice has been re-inaugurated, viz. informal meetings of Fellows on certain Wednesday evenings from November to June. At these Sectional Meetings, which are under the direction of Mr. Cheshire, Dr. C. Price-Jones, and Mr. D. J. Scourfield, there will be exhibits, short papers, and discussions, relating to (1) Brass and Glass; (2) Bacteriology and Protozoology; and (3) Pond-life.

On December 16, 1908, a Special Meeting was held, in response to a demand by eleven Fellows, for the purpose of considering the amendment to the By-laws in reference to the admission of female Fellows to the Meetings, and to participating in the management of the Society. After discussion, the following resolution was passed:—

"That in the opinion of this Meeting the time has now arrived when the question of the admission of women Fellows to the full privileges of the Society must be seriously considered, and that a special committee be appointed for the purpose of considering the proposals dealing with this subject, and preparing a report thereon, to be submitted to a further special Meeting of the Society to be called for the purpose by the Council."

The Council anticipates that the special committee will be able to report in the course of a few weeks, and that the question will be settled during the current session.

The Treasurer also submitted his Statement of Accounts and duly Audited Balance Sheet.

The President, in moving that the Report of the Council and the Treasurer's Balance Sheet be received and adopted, and printed and circulated in the usual way, said that, though their balance in hand was

CASH STATEMENT FOR THE YEAR ENDING 31ST DEC. 1908.

Dr.

				£	s.	d.
To Balance from 1907				53	4	3
,, Admission Fees				27	6	0
,, Annual Subscriptions—						
1904	£3	3	0			
1905	1	11	11			
1906	19	10	2			
1907	31	17	0			
1908	533	1	6			
1909	27	15	10			
1910	1	1	0			
				618	0	5
,, Interest on Investments				59	15	6
,, Sale of Journals				287	5	3
,, Advertisements				60	0	0
,, Sale of Surplus Books				3	10	0
,, ,, Reprints and List of Fellows				7	13	3
,, Income Tax returned, etc.				3	12	9
,, Sale of Tools				0	4	0
,, Donation to Library Catalogue				1	1	0
,, Deposit				200	0	0
				£1321	12	5

Cr.

				£	s.	d.
By Rent, Coals, etc.				132	10	0
,, Salaries and Reporting				161	18	0
,, Books and Periodicals purchased				100	11	2
,, Bookbinding				2	1	0
,, Expenses of Journal—						
Editing	£155	10	9			
Illustrations	35	15	2			
Printing and Postage	416	12	4			
				607	18	3
,, Purchase of 38*l.* 14*s.* 3*d.* New South Wales Three and a Half per Cents.				38	16	4
,, Refreshments at Meetings				13	10	0
,, Stationery				17	7	1
,, Fire Insurance				3	5	0
,, Postage and Petty Disbursements				36	13	7
,, Rent of Stock of Journals				4	9	6
,, Repairs				0	6	6
,, Deposit Withdrawn				200	0	0
,, Balance to 1909				2	6	0
				£1321	12	5

Investments.

	£	s.	d.
North British Railway	400	0	0
Nottingham Corporation Stock Three per Cents.	400	0	0
New South Wales Three and a Half per Cents.	400	0	0
India Three per Cents.	700	0	0
Metropolitan Water Board B Stock	120	0	0
	£2020	0	0

WYNNE E. BAXTER, *Treasurer.*

We have examined the foregoing Account, and compared the same with the Vouchers in the possession of the Society; we have also verified its Securities as above mentioned, and find the same correct.

D. J. SCOURFIELD } *Auditors.*
C. LEES CURTIES }

January 14, 1909.

only a small one, it was satisfactory to note that it was on the right side. As regarded the mention in the Report of their exhibit at the Franco-British Exhibition, he should have been very glad to have coupled Mr. Gordon's name with that of Mr. Rousselet, with whom he had been associated in making the arrangements, but with his usual modesty Mr. Gordon had not wished this to be done, and as he was a Member of the Council and one of their Hon. Secretaries it was agreed that the name should be omitted.

The Motion was then put to the Meeting and carried by acclamation.

The Scrutineers, having handed in their Report on the result of the ballot, the following gentlemen were declared to have been unanimously elected as Officers and Council of the Society for the ensuing year :—

President—Sir Edwin Ray Lankester, K.C.B. M.A. LL.D. F.R.S. F.L.S. F.Z.S.

Vice-Presidents — Frederic J. Cheshire ; Rev. W. H. Dallinger, LL.D. D.Sc. D.C.L. F.R.S. F.L.S. F.Z.S. ; The Right Hon. Sir Ford North, P.C. F.R.S. ; E. J. Spitta, L.R.C.P. (Lond.) M.R.C.S. (Eng.).

Treasurer—Wynne E. Baxter, J.P. F.G.S. F.R.G.S.

Secretaries—R. G. Hebb, M.A. M.D. F.R.C.P. ; J. W. Gordon.

Ordinary Members of Council—F. W. Watson Baker ; A. N. Disney, M.A. B.Sc. ; J. W. H. Eyre, M.D. F.R.S. (Edin.) ; Edward Heron-Allen, F.L.S. F.Z.S. F.R.Met.S. ; Henry Geo. Plimmer, F.L.S. ; Thomas H. Powell ; C. Price-Jones, M.B. (Lond.) ; P. E. Radley ; Julius Rheinberg ; Charles F. Rousselet ; F. Shillington Scales, M.A. (Cantab.) ; David J. Scourfield, F.Z.S.

Librarian—Percy E. Radley.

Curator of Instruments, etc.—Charles F. Rousselet.

Curator of Slides—F. Shillington Scales, M.A. (Cantab.).

The President then read his Annual Address, entitled "On Seeds, with Special Reference to British Plants." In this he more particularly dealt with the seeds of Gymnosperms and Monocotyledons, in continuation of the address of the previous year, in which the seeds of Dicotyledons were considered. At the conclusion of his address the President took the opportunity of thanking the Society and the Council for their courtesy and kindness to himself during his period of office ; especially he wished to thank their Secretaries, Dr. Hebb and Mr. Gordon. He felt all the more grateful to them because, on account of important debates in the House of Lords having been fixed for the nights of the Society's Meetings, he was prevented from attending so regularly as he could have wished. He might also mention that he had for more than half a century been a Member of the Society, and was, in fact, one of their two or three oldest Members. He congratulated the Society upon having elected as their next President Sir Edwin Ray Lankester, and it was a matter of satisfaction to him to know that his successor in that chair would be one of the most able naturalists in this country and in the world. He hoped the Society would be even more prosperous in the future than in the past.

Dr. D. H. Scott said he rose to propose the thanks of the Society to Lord Avebury for what they must all feel had been an extremely interesting address. He was sorry to think that Lord Avebury's presidency would now end, but he was quite sure they would all agree with the President's remarks as to his successor, Sir E. Ray Lankester. The subject chosen was not only remarkable in itself for the interest attaching to it, but Lord Avebury spoke upon it with an authority possessed by no one else—they all knew his books on seedlings, so closely related with the subject of his address, and there was simply an infinity of points of interest which had been touched upon, as they would realise even better when they came to read the paper in print. The study of seeds was of great botanical importance from many points of view, and he had himself been particularly interested in their early history. He did not think anything like all the categories of seeds enumerated seemed to have been represented in the Palæozoic floras. They did not, for example, find there the very small seeds like those of Poppies or Orchids, which did not appear to have been elaborated then, which was curious because the sporangium from which the seed was presumably derived was of comparatively small size; the fleshy, drupe-like seeds of the Cycad type were, however, very characteristic of Palæozoic times. The work of Mr. Clement Reid had been attended with remarkable success in identifying the plants of the Glacial and Post-Glacial periods by means of their seeds, results which had only been obtained by very minute study. The glimpses which they got all through the address of the innumerable adaptations for the dispersal of seeds were always very fascinating, and although there were persons in the present day who sought to minimise the importance of adaptation, he had always thought it was the great point of Darwin's theory that it alone afforded an explanation, other than a supernatural one, of teleology. He had much pleasure in moving that the best thanks of the Society be given to Lord Avebury for his address, and that he would allow it to be printed in the Journal of the Society.

Mr. Wynne E. Baxter had much pleasure in seconding the resolution, especially as it gave him an opportunity of expressing the pleasure all felt to see the ex-President amongst them again. Lord Avebury was almost the oldest Fellow of the Society, and his engagements were certainly as numerous as most. He thought, therefore, they would understand that their President had had great difficulty in being able to come to their Meetings, and they were all very much obliged to him for coming as often as he could. He hoped that his lordship had yet many years of health and usefulness before him.

Dr. Scott having put the resolution to the Meeting, it was carried unanimously, with applause.

The President said he was very much obliged to Dr. Scott and to their Treasurer for their extremely kind remarks. Dr. Scott had made some very interesting suggestions with regard to the older plants, but it should be remembered that it was the parasitic plants which had the small seeds, and it seemed quite natural that in the Carboniferous periods there should have been no seeds adapted to birds, because there were no birds till long subsequently. He thanked the Fellows of the Society very heartily for their resolution.

Mr. J. M. Offord moved that the thanks of the Society be given to the Honorary Officers of the Society for their services during the past year. They were greatly indebted to them for the time and attention given to its affairs, and for the large amount of work done, and though much of this was not known to the Members generally, they were very glad to have this opportunity of expressing their appreciation of the management of the Society.

Mr. Plaskitt having seconded the motion.

The President said that, though he had not been able to attend all the Meetings, he had been often enough to appreciate the very valuable services rendered by the Officers and Council. The motion was then put to the Meeting, and carried unanimously.

Mr. J. W. Gordon said he had been asked to acknowledge this vote of thanks on behalf of his colleagues, and thought that the selection had fallen upon him because he happened to be the junior member of the party. So far as he knew, the chief anxiety connected with their work lay with their Honorary Treasurer in the matter of getting in the subscriptions; but apart from the annual difficulty arising from how to meet their expenses, the rest of their duties were a pleasure, bringing them into pleasant contact with many friends connected with the Society. He could only assure them that their best efforts would be made in the interest of the Society during their coming year of office. Whilst speaking, he would take the opportunity of reminding them that the next meeting of the "Brass and Glass" section would take place on Wednesday the 27th inst.

Mr. W. J. Marshall moved a vote of thanks to the Auditors and Scrutineers for their services.

Mr. Gardner having seconded the motion, it was put to the Meeting by the President, and unanimously carried.

The following Instruments, Objects, etc., were exhibited :—

The Society :—Twelve Slides of Foraminifera, dredged from off the coast of Somaliland.

Messrs R. and J. Beck :—Dr. Buchanan's Corneal Microscope.

Messrs. Watson and Sons :—New "Club" Portable Microscope and New "Standard" Microscope, for students.

Mr. F. J. W. Plaskitt :—Photomicrographs of *Podura* scale, showing transverse markings.

New Fellows :—The following were balloted for and duly elected *Ordinary* Fellows of the Society :—Fred. William Gordon, Ernest Heath, Robert Kennedy Levett, and Edward James Sheppard.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

APRIL, 1909.

TRANSACTIONS OF THE SOCIETY.

VII.—*The President's Address: On Seeds, with Special Reference to British Plants.*

By The Right Hon. Lord Avebury, P.C. D.C.L. LL.D. F.R.S.

(*Read January* 20, 1909.)

Following to some extent the example of my distinguished predecessor, I devoted my Address last year to the consideration of "Seeds, with Special Reference to British Plants," but time and space compelled me to restrict my remarks to Dicotyledons. At the same time, however, I intimated that if it met with your approval I should hope this year to deal with the Gymnosperms and Monocotyledons.

Your courtesy in printing the Address, and the demand I have experienced for separate copies, encourage me in the hope that I shall be acting in accordance with your wishes in carrying out this year the remainder of my programme.

Gymnosperms.

Coniferæ.—Although the Coniferæ form so important an element in our woodland scenery, they are only represented in Britain by four indigenous and one introduced, or, rather, re-introduced species, belonging to three, in many respects very distinct, genera. The flowers are monœcious or diœcious; the ovules and seeds are naked, that is to say, there is neither ovary, style, nor pericarp. The fruits differ widely in aspect, though in origin they are similar.

In the Pines, Firs, etc., the micropyle points away from the free margin of the scale; in the Cypresses, on the other hand, towards the free margin, and away from the axis of the cone.

The cotyledons are often numerous.

In the Ginkgo tree (*Ginkgo biloba*) the integument of the seed becomes succulent and is of a bright orange colour. It is a remarkable species in many ways. It possesses mobile antherozoids,* a provision which does not, so far as we know, occur in any Phanerogams, or in any other Gymnosperms except *Cycas* and *Zamia*. They swim by means of ciliæ.

Pinus sylvestris (the Scotch Pine).—The fruit is a cone, consisting of more or less hardened, imbricated scales, each protecting two winged seeds (fig. 20). These are easily transported by the wind, and the cones themselves are often carried by squirrels and birds. The scales are more or less thickened, or "umbonate," at the apex, and especially on the outer aspect.

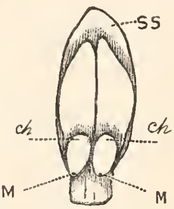

Fig. 20.—Seeds of Scotch Pine. Nat. size.

SS, seed-scale; *ch*, chalaza; MM, micropyles of the two seeds.

The cones take two years to ripen, and often remain for several more attached to the tree. Sooner or later, however, the scales open in dry and warm weather, liberating the seeds. These are produced into a wing four or five times as long as the seed itself. The wing is straight on one edge, and more or less curved on the other. This form is due to there being two seeds to each scale.

The texture of the wing is very thin, pale brown, subtransparent, and finely striate longitudinally. As in many other cases where there is a single wing, the centre of gravity is excentric, which gives the seed a spinning motion, and thus facilitates its passage through the air.

In several species of Pine, as, for instance, in *P. serotina*, the scales are produced into sharp spines, which serve to protect the seeds. In other cases they are protected by the resin contained in the scales. The development of the seed is slow.

The pollen is shed in spring, it then remains dormant, or, rather, completing its development, for more than a year, and the ovule is not fertilised till the following July, more than twenty months after its commencement.

Juniperus.—We have two species. In *J. communis* the flowers are usually diœcious.

The fruit of the Juniper is known as a galbulus. It is composed of decussating whorls of three scales, which are evidently homologous with leaves, and serially continuous with them. The

* Hirase, Journ. Coll. Sci. Imp. Univ. Japan, 1895 and 1898.

outer or lower whorls remain small and infertile; the scales are triangular, with an acute cuspidate point, and arranged in six rows. The leaves of one or two of the inner whorls alone are fertile, each bearing one or two ovules. These enlarge, gradually envelop the seeds, become fleshy and more or less connate, forming what appears to be a berry, at first green but ultimately blue-black and glaucous. It takes two years to mature. Each fruit contains three to six, or even more, seeds. The seeds are ovoid or trigonous, or variously angled by mutual pressure, and contain much resin. The testa is hard and bony.

In *J. nana* the fruits are rather longer in proportion.

Taxus (the Yew).—In the Yew the flowers are mostly diœcious; the scales remain small and infertile, while a single ovule at the apex of the twig develops, and is surrounded by a large, cup-like, pulpy aril. This is a favourite food of thrushes, which either swallow the fruit entire, or reject the stone when swallowing the aril. In either case the hard woody coat of the seed preserves it from digestion, and it passes through the alimentary canal without injury to the embryo.

CYCADACEÆ.—The Cycadaceæ, which used to be placed near the

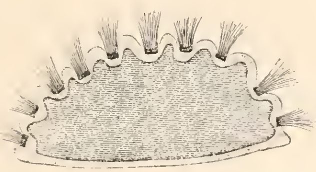

FIG. 21.—*Cycas*. Section through nearly ripe spermatozoid. × 300. After Ikeno. (From Journ. Coll. Sci. Imp. Univ. Tokio, 1898–1900, pl. xiii. fig. 32.)

FIG. 22.—Mature antherozoid of *Zamia*. × 90. After Webber. (From Bot. Gaz., xxiv. 1897, p. 18, fig. 4.)

Palms, or even the Tree-ferns, are evidently more nearly related to the Conifers.

The ovules are naked, sessile, and orthotropous. The seed is drupe-like, with several openings corresponding to the embryonic vesicles, from which proceed folded cords, terminating in embryos, one of which only is developed. The testa is fleshy outside, crustaceous within; the albumen is fleshy, with a central cavity in which is the embryo. The cotyledons cohere so closely, that there seems to be only one.

A very remarkable point connected with the Cycadaceæ is that, as already mentioned, they possess mobile so-called spermatozoids. The large pluricellular pollen-grains are sucked into the pollen chamber, which is provided with a special strand of tracheides to insure a supply of moisture, and there undergo a period of maturation, after which free-swimming bodies are liberated. These, therefore, do not correspond to the pollen of other plants, but to the special fertilising cell. The possibility of this was long ago foreshadowed by Hofmeister and by Pringsheim.

This remarkable fact was first discovered by Hirase * in *Salisburia*, confirmed by Ikeno † in *Cycas* (fig. 21), and by Webber ‡ in *Zamia* (fig. 22).

The antherozoids of the *Ginkgo* are egg-shaped, those of *Zamia* are pear-shaped, with a spiral ciliated band.

Monocotyledons.

Hydrocharideæ.—The species of this order are aquatic, mostly submerged, and in some cases marine, occurring on the shores of the Indian and Pacific Oceans, and of the West Indian islands. There are fourteen genera, and about forty species.

The flowers are produced singly, or several together in spathes, which raise themselves above the water, when the flowers are about to open.

The ovary is inferior, 1-celled, with three parietal placentas, or divided, sometimes into as many as nine cells. The fruit, which is small and indehiscent, ripens under water. The seeds are few or many. They are generally small, covered with filaments or spiny in *Limnobium*, rugose or spiny in *Thalassia*. There is no albumen. We have two native genera, each with one species.

Hydrocharis Morsus-ranæ, the Frogbit, is a floating plant; the perianth has three outer segments, which are pale green, shorter and narrower than the inner ones, which are white.

The fruit is fleshy, small, ovoid or narrowed at the base in its early stages, and strongly 6-ribbed, indicating the six carpels of which it is composed. The ovules are numerous and inserted on the septa, but only a few develop into seeds, which are small, ovoid, and imbedded in a jelly-like mucus or pulp. These are not naturally liberated until the decay of the fruit, which, however, is no doubt often attacked by birds and other animals, which thus effect the distribution of the seeds.

The plant, like many other aquatic species, also multiplies by

* Hirase, S., "On the Spermatozoid of *Ginkgo biloba*." Bot. Mag. Tokio, x.(1896). "Étud. s.l. fecondation et l'Embryogenie du *Ginkgo biloba*." Journ. Coll. Sci. Imp. Univ. Japan, 1895.

† Ikeno, S., "Unt. u.d. Entw. d. Geschlechts organ bei *Cycas revoluta*." Journ. Coll. Sci. Imp. Univ. Japan, 1890. See also Jahr. f. Wiss. Bot., xxxii. heft 4 (Leipzig, 1898).

‡ Webber, H. J., "Spermatogenesis of *Zamia* and the Pollen-tube App. of *Ginkgo*." U.S. Dep. of Agric. Washington, 1901. "Div. of the Antherozoids of *Zamia*." Bot. Gaz. Chicago, 1897.

means of small ovoid bulbs or bulb-like structures, which detach themselves from the parent plant, and no doubt are carried about by the water or by animals.

Though we have only two native species, a third representative of the order, *Elodea canadensis*—a native, as its name denotes, of North America—is now firmly established in our waters. It appeared in Ireland in 1836 and in Great Britain a few years later, and spread rapidly. The plants are diœcious, and the male, which is rare in America, has not yet been observed here, except near Edinburgh.

The plant is very brittle, which materially assists in its dispersal.

Stratiotes.—The male flowers of *Stratiotes* have about twelve fertile stamens, and fifteen to thirty others which serve as honey-glands. The female flowers have similar honey-glands. It is said that in Northern Europe no male flowers have been observed, while in Holstein they are not infrequent. The increase is with us mainly by offshoots. During the winter the plant remains at the bottom of the water. In spring it rises to the surface, producing fresh leaves, flowers, and floating roots. After flowering it again sinks, so that the seeds ripen in safety. Young plants are also produced at the end of long stalks which spring from between the leaves. Towards the end of August the plant rises a second time, and is at first surrounded by the young ones. The connecting stalks then die and decay, thus setting them free. Finally, they descend to the bottom for the winter.

ORCHIDACEÆ.—We have in Britain sixteen or seventeen genera and about forty-four species. The ovary is inferior, 1-celled, with three parietal placentas, though there are a few species of *Cypripedium* in which the ovary is perfectly 3-celled.

The testa is loose and reticulate, in a few cases flattened out into a wing. These, and indeed all the seeds, are no doubt dispersed by the wind. They would, moreover, of course readily adhere to any passing animal.

The capsule is 3-valved, with innumerable minute more or less fusiform seeds (fig. 23). It has been estimated that a capsule

FIG. 23.—Seed of *Orchis maculata*. × 40.

of *Cattleya* contains more than 1,000,000, and the seed of *Goodyera repens* is said to weigh only 0·000002 of a gram.

In some tropical Orchids, as, for instance, in *Vanda*, the fruits contain, besides the small seeds, hair-like cells with obliquely pitted walls. These are very hygroscopic, and twist about if the conditions of the air vary, thus carrying the seeds from the interior to the surface of the capsule, and exposing them to the action of wind.

In some species the ovules are undeveloped or very rudimentary when the plant is in flower. According to Hildebrand, in *Dendrobium* the formation of the ovules has not yet commenced, even the placentæ are not fully developed, and it is not till four months after the deposition of the pollen that the formation of the embryo begins.

IRIDEÆ.—The flower is superior, with six petal-like leaves. The ovary is inferior, 3-celled, with many ovules.

The order is a large one, comprising 700 or more species, inhabiting especially South Africa and other dry, sunny climates. Five genera and six species only are truly British, four others being more or less naturalised.

The fruit is a capsule, bursting from the apex to the base into three valves, along the line of the dorsal suture. Each cell may contain few or many seeds, superposed in a double row. The seeds of our British species are relatively large, but differ considerably in this respect. They may be globose, angled, flattened, and sometimes winged. At least two types may occur in the same genus. The embryo is small.

Iris.—We have two species, *I. fœtidissima*, the Blue, and *I. Pseudacorus*, the Yellow Flag.

The seeds of the former are large, globular, smooth, glossy, and rich orange-red, or even scarlet. The bright colour, perhaps, deceives birds into the belief that they are sweet, and may thus assist in their dissemination. The testa is fleshy.

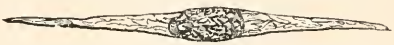

FIG. 24.—Seed of *Drosera rotundifolia*. × 20.

The seeds of *I. Pseudacorus* are yellowish-red or brown; more numerous, much flattened by mutual pressure, when young and soft. The testa is less spongy than in *I. fœtidissima*.

The seeds of *Gladiolus illyricus* have a narrow wing. In *G. communis* it is broader. The capsule opens at the upper end and the seeds are jerked out. Perhaps their bright colour may assist in their dispersal by birds.

DIOSCORIDEÆ.—The flowers are unisexual, with a perianth of six divisions. The stamens are also six in number. The ovary is inferior, 3-celled, and with one to three ovules in each cell. Styles or stigmas, three. The embryo is minute, and the albumen hard.

The order includes eight genera, with about 200 species, mostly inhabitants of hot countries. The fruits are baccate in about half the species, and capsular in the other half. The seeds are globose, or flattened, and even winged, as in *Dioscorea*.

Two species only are European.

We have only one British, the Black Bryony, *Tamus communis.* It does not extend to Scotland or Ireland, and is, indeed, confined to the South of England. It is widely distributed over Europe, North Africa, and temperate Asia.

The flowers are small, yellowish-green, in slender racemes. The berry is oblong, indehiscent, bright red at maturity, and contains about five seeds.

The seeds are large, globular, minutely and finely netted, the meshes being arranged, more or less regularly, in longitudinal lines. They are slightly flattened at each end, like an orange. The testa is membranous, and light reddish-brown.

The fruit, though not attractive to us, is eaten by birds. The seeds, being very hard, no doubt escape digestion, and are in all probability as a rule rejected.

The cotyledon has lost almost all trace of its leafy character, and seems to absorb nourishment from the seed.

In the first year only one leaf develops. It is situated almost, or perhaps directly opposite to the cotyledon, so that it might easily be taken for a second cotyledon.

Miss Sargant * has adopted the suggestion originally made by Agardh, that the Monocotyledons are derived from Dicotyledonous ancestors, and their single cotyledon is derived from the fusion of the two cotyledons of their ancestral Dicotyledon. Some of the Ranunculaceæ show, no doubt, a tendency in this direction, as, for instance, species of *Ranunculus*, *Trollius*, *Delphinium*, *Anemone*, *Aconitum*, *Eranthis*, etc. More or less similar cases occur in other orders, as, for instance, in *Corydalis.* Miss Sargant also points out that some Monocotyledonous cotyledons seem to show traces of a double origin: thus, that of *Chamærops humilis* has a bifid apex, and that of *C. Fortunei* is even more completely bilobed. I doubt, however, whether these cases have in reality any bearing on the problem. It seems more probable † that the advantage is in giving greater strength.

On the other hand, Mr. Hill ‡ considers that the Monocotyledonous habit may have been acquired by the adaptation of the two cotyledons of the ancestral Dicotyledons to different functions —one acting as a suctorial organ, the other developing into a typical aerial leaf.

Amaryllideæ.—The ovary is inferior and 3-celled. The fruit is a capsule, opening in three valves, loculicidally, or fleshy and indehiscent. The seeds are few, numerous, or reduced to one only.

The order comprises about sixty genera and 650 species, mostly perennial and bulbous. The species grow mostly in tropical and warm regions. We have three genera and four species, two of

* Sargant, Ann. of Bot., xvii.
† Avebury, "On Seedlings," pp. 90–97.
‡ Ann. of Bot., xx. (1906).

which, however, are so often grown in gardens that it is very doubtful whether they are truly native.

The seeds are sometimes flattened, or angled by mutual pressure.

LILIACEÆ.—Over 2500 species are recorded, generally annual or perennial herbs, often bulbous, but sometimes shrubby, or even in some few cases attaining the size of a tree. The bulbous species are partial to dry, sandy, or gravelly soil, the alluvial banks of rivers, meadows, and woods.

In Britain we have nineteen genera and thirty-six species.

The ovary is free, 3-celled, with several or rarely only one ovule in each. The fruit of our British species is a capsule, except in *Paris, Ruscus, Asparagus, Polygonatum, Maianthemum*, and *Convallaria*, which have baccate fruits. These are red, except in *Paris* and *Polygonatum*, which have bluish-black berries. The carpels of *Tofieldia* are almost free, and might be called follicles.

The seeds are generally globose, and very hard in *Ruscus, Asparagus, Convallaria, Polygonatum, Maianthemum, Simethis, Scilla nutans, Muscari racemosum, Ornithogalum nutans, Gagea, Paris*, and *Colchicum*.

Scilla verna, S. autumnalis, and *Ornithogalum* have smaller capsules and angular seeds, as also have some species of *Allium* (the Onions) and *Lloydia*.

Fritillaria, Tulipa, and *Lilium* have a different type of seed. In these species they are very numerous, and superposed in two rows, densely packed, much compressed and flattened, horizontal, and more or less winged.

Some species multiply by means of bulbils or small lateral bulbs. These send out roots which grow horizontally at a right angle to the axis of the parent bulb. They attain a considerable length, and when they cease growing they are said to contract and thus to draw the young bulbil away from the parent bulb. Such cases are said to occur in *Allium, Muscari, Ornithogalum* and *Tulipa*.

Lilium bulbiferum of the Swiss Alps, which is sometimes considered, as for instance by Grenier and Godron,* to be a local form of *L. croceum*, hardly ever produces fruits, but is propagated by bulbils, which are formed in the axils of the leaves. Kerner states† that there is no difference noticeable in the structure of the flowers in these two Orange Lilies, and it is difficult to explain their difference in mode of propagation, save on the assumption that in the regions where *L. bulbiferum* grows, those insects are wanting which should convey its pollen from flower to flower. As the Orange Lily possesses no arrangements for autogamy, no fruits are formed in the absence of insect-visits. It appears that this plant has lost the capacity for autogamy; at any rate if a

* Flore de France, iii. p. 182.

† Nat. Hist. of Plants, ii. p. 461.

stigma be pollinated with pollen from the same flower, on plants in a garden, no result follows. On the other hand, offshoots in the form of numerous bulbils are produced by *L. bulbiferum*, by means of which it is propagated and dispersed. In several valleys of the Central Alps it does not flower at all, and thus obviously depends entirely upon its bulbils for propagation.

Allium (*A. Ampeloprasum*).—The fruit is a trigonous 3-celled capsule, dehiscing at the dorsal suture. One or two seeds in each cell come to maturity; they are more or less acutely angled, conforming to the cavity of the cell. The testa is membranous, black, and more or less wrinkled. It is generally carried up on the tip of the cotyledon during germination. One variety has bulbils at the base of the umbel.

A. ursinum.—According to Scott Elliot, the seed of this species germinates at the surface of the earth, but is then carried down to a depth of 3–4 mm. by a peculiar elongation of the stalk of the cotyledon.

Paris.—In *P. quadrifolia* the ovary is a bluish-black or dull reddish colour, which perhaps attracts flies by its resemblance to a piece of decaying meat.

Asparagus.—In *A. officinalis* the fruit is also a berry, globose, smooth, shining, red, and 3-celled, with three to six seeds. These are large, flattened on the ventral aspect, hard, black, and smooth to the naked eye. Their dispersal is evidently due to birds.

Scilla (*S. nutans, or festulis*), the Bluebell Scilla.—The fruit is a 3-celled, many seeded capsule, dehiscing from the apex about half way down, so that it forms a cup, out of which the seeds are jerked by the wind, or by passing animals. As is so often the case in plants having such an arrangement, the seeds are black and glossy.

Ornithogalum (*O. nutans*).—In this species the arrangement resembles that in *Scilla nutans*. The seeds, as in that species, are black and glossy.

Narthecium (*N. ossifragum*).—In this species also the fruit is a

Fig. 25.—Seed of *Narthecium ossifragum*. (From "Notes on British Flowering Plants." Macmillan & Co.)

capsule, which dehisces at the summit, and the seeds are jerked out as in the preceding species. They are, however, very different, being small, narrowly oblong, striate and pale yellow. The testa at each end is prolonged into a long, slender, colourless tail. The central part is only 1·5 mm. in length, while that of the whole seed is 8–9 mm. (fig. 25).

This peculiar form would perhaps enable them to float longer, and prevent them from sinking into the marsh. It could also serve to attach them to aquatic plants, and to birds.

Seeds of this peculiar form also appear in *Nepenthes.*

Colchicum (*C. autumnale*).—What appears to be the flower-stalk is really the tube of the corolla, and the ovary is underground. Perhaps the advantage of this is that as the plant is an autumn flower, and lives in northern and mountainous districts, the seeds would not have time to ripen before the cold weather sets in. The seed capsule remains, however, underground all the winter, rising to the surface and ripening its seeds in the following spring.

The seeds have a comparatively large caruncle, which becomes viscid when wet, and thus adheres to the feet of passing quadrupeds.

JUNCACEÆ.—The fruit of this order also consists of three carpels, and is either 1-celled or 3-celled according to the degree of development of the septa. The seeds are in some species few, in others numerous. The capsules dehisce in a variety of ways, the most frequent being loculicidal, while some are indehiscent. Our two British genera, the Rush (*Juncus*) and the Wood-rush (*Luzula*) are very widely distributed on the earth's surface, while the other genera are confined to the Southern Hemisphere.

About 200 species have been described.

The seeds are ovoid, elliptic, or globose; very rarely flattened.

Juncus (the Rush).—The fruit is a capsule, opening at the summit, and from which the seeds are jerked. The elasticity of the rigid stem assists in this considerably.

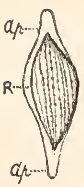

FIG. 26.
Seed of *Juncus acutus.* × 15.
ap, *ap*, appendage; R, raphe.

The seeds differ considerably in size and number. Another striking difference is that in some species the testa is closely applied to the endosperm; while in others it is produced into a loose colourless tail at each end, which is continuous with the funicle or seed stalk at the base.

The first group includes *J. conglomeratus*, *J. effusus*, *J. glaucus*, *J. balticus*, *J. filiformis*, *J. squarrosus*, *J. compressus*, *J. articulatus*, *J. supinus*, *J. lamprocarpus*, and *J. bufonius.*

The testa is prolonged and colourless in *J. acutus* (fig. 26), *J. maritimus*, *J. triglumis*, *J. biglumis*, *J. trifidus*, and *J. castaneus.* This form reminds us of that in *Narthecium ossifragum*, and may be an advantage for the same reason.

The largest seeds are those of *J. squarrosus*, *J. acutus* and *J. supinus*, while those of *J. lamprocarpus*, though the plant is many times larger, are very small, but much more numerous.

A remarkable feature in the flowering of rushes is that it occurs in pulses. For some days, perhaps, no flowers will be open; then, suddenly, without apparently any change in the weather to account for it, the flowers will all open together. The feature is especially marked in the species which have single, or few flowers. For wind-fertilised species the arrangement is obviously advantageous. The flowers open once for all.

Luzula (Wood-rush).—The capsules are 1-celled, with only three seeds, one for each carpel. The seeds are much larger than in *Juncus.*

Those of *L. campestris* have a marked prolongation of the testa at the base; those of *L. Forsteri*, on the contrary, at the apex.

TYPHACEÆ. — The Typhaceæ are monœcious wind flowers. The fruit is a small seed-like nut of one or two carpels, 1 or 2-celled, with a solitary penduious seed in each cell, on a long thread-like stalk, which bears long silky hairs, insuring dispersal by the wind. The albumen is copious.

The order is a very small one, comprising only sixteen species, of which seven are British. They are distributed over Europe, temperate and tropical Asia, Australia, and the temperate parts of North America, in shallow streams, ponds, and marshes.

In Britain we have two genera, *Typha* and *Sparganium*; the former with two, the latter with three or perhaps five species.

Typha (the Reed-mace).—The inflorescence is a cylindrical spike, sometimes interrupted in the middle, with male flowers above and female below. The fruit is reduced to a single carpel with one seed, having a striated testa, and conforming to the cavity of the carpel. They are small, densely packed, terminated by a long style, and enveloped in a copious down (fig. 27), and the whole is so fluffy, or chaffy, and light, that it is easily blown about by the wind, or by the water, on which the seeds would float.

Sparganium (Burr-reed).—In *Sparganium* the flowers form globular heads, placed at intervals along the summit of the stem, with leaf-like bracts under the lower ones. The upper heads are male, the lower ones female, consisting of sessile ovaries, each surrounded by three or six scales, forming a perianth.

Each fruit consists of one or two carpels, and when mature consists of an ovoid seed, on a cuneate base, as if stalked, and terminating in a beak, which is 1- or 2-celled, thick-walled, spongy, and indehiscent.

S. ramosum has the inflorescence branched and the beak short, as it is also in *S. minimum.* In *S. simplex* it is much longer.

AROIDEÆ. *Summary of the Order.*—Though represented in Britain by three species only, the order is a large one, including 98 to 100 genera and 900 or more species, abounding in the tropics of both hemispheres, climbing to the tops of tall trees, and forming the chief constituent of the lianes of tropical forests. Many of them

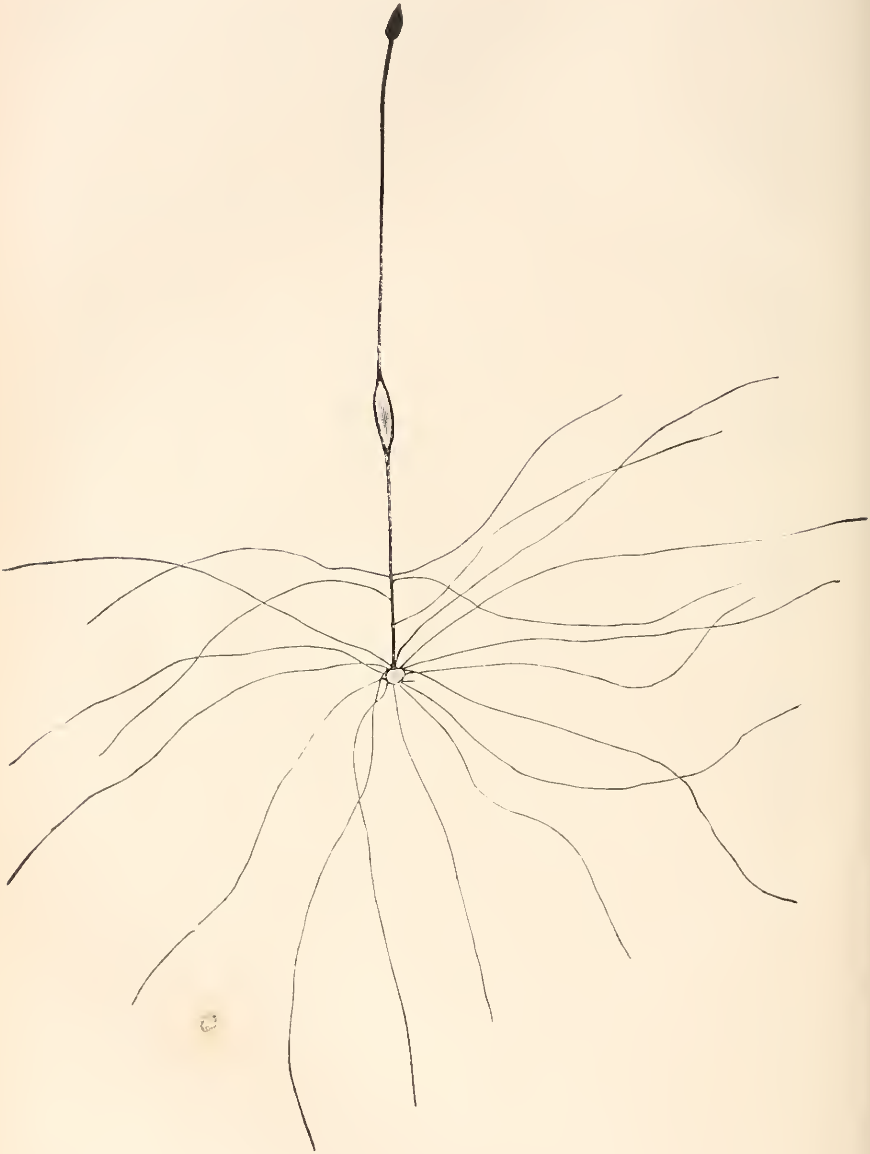

Fig. 27.—Seed of *Typha*.

are lowly herbs with handsome foliage, gorgeously variegated in the case of *Caladium* and other species, while others, like *Dieffenbachia*, are richly blotched with cream or yellow markings. Some are aquatics, growing in shallow water, like *Orontium*, *Calla*, and *Acorus*, while *Pistia stratiotes* is a floating herb. Some of the purely herbaceous species attain a gigantic size, as in the case of *Amorphophallus*, but particularly *Conophallus titanus*, which produces a single leaf, with a stalk 6–7 ft. high and a blade 45 ft. in circumference. The spathe measures 3 ft. in diameter, making one of the largest known flowers, popularly so-called.

In temperate regions the plants are chiefly dwarf herbs, and to this class belong the land plants, *Arum maculatum* and *A. italicum*, as well as the aquatic *Acorus*, or Sweet Flag. The highly coloured fruits of *Arum* are probably adapted for dissemination by birds, but *Acorus Calamus*, with its curious, but inconspicuous and unattractive, conical mass of fruits, must be generally dispersed by water, carrying away the fruits or pieces of the plant. The seeds do not often come to maturity in this country, but when that happens, the pulpy baccate fruits may induce aquatic birds to carry them away.

The curious flowers of the common *Arum maculatum* Linn. (Lords and Ladies) are crowded together in four series on a central axis, or spadix, inclosed by a large spathe in direct correlation to the method by which they are fertilised. Near the base of the spadix is a group of ovaries, without a protecting perianth, as this is rendered unnecessary by the presence of the spathe. Above this is a group of hairs, representing imperfect ovaries. Next comes a dense cylindrical mass of anthers, likewise without a perianth, and above them is another group of hairs, representing imperfect anthers. The crowding together of the flowers in this fashion would tend to reduce the size of the ovaries and their contained ovules or seeds. This may account for the presence of infertile ovaries and anthers, so that the energies of the plant are devoted to the production of only a few ovules and still fewer seeds.

In this case, nothing would at first sight seem easier or more natural than that the pollen from the anthers should fall on, and fertilise, the pistils. This, however, is not what occurs. The stigmas mature before the anthers, and by the time the pollen is shed, have become incapable of fertilisation. It is impossible, therefore, that the plant should fertilise itself. Nor can the pollen be carried by the wind. When it is shed, it drops to the bottom of the tube, where it is so effectually sheltered that nothing short of a hurricane could dislodge it; and although *Arum* is common enough, still the chances against any of the pollen so dislodged being blown into the tube of another plant would be immense.

As, however, in *Aristolochia*, so also in *Arum*, small flies, especially those belonging to the genus *Psychoda*, attracted by the showy central spadix, the peculiar smell, the prospect of honey, and perhaps of shelter, enter the tube while the stigmas are mature, and find themselves imprisoned by the fringe of hairs, which, while permitting their entrance, prevent them from returning. After a while, however, the period of maturity of the stigma is over, and each secretes a drop of honey, thus repaying the insects for their captivity. The anthers then ripen and shed their pollen, which falls on and adheres to the insects. Then the hairs gradually shrivel up and set the insects free, which carry the pollen with them—so that those which then visit another plant can hardly fail to deposit some of it on the stigmas. Often more than a hundred small flies will be found, and in one case Knuth counted no less than 4000 in a single *Arum*.

Another explanation of the floral mechanism in *A. maculatum* has recently been suggested by Father Gerard. He considers that the honey secreted by the stigmas has a stupefying effect on the insects, which are killed and ultimately digested in the interior of the spathe. The insectivorous habit is deduced from the presence of dried remains of flies on the walls of the cavity. Schnetzler had previously claimed a similar insectivorous habit for *A. crinitum*. Self-pollination is not, he thinks, precluded in *A. maculatum*, some of the stigmas being still functional when the anthers dehisce.

The mature fruit is sometimes 12–14 mm. in diameter, this being made up of the fleshy ovary, which becomes pulpy, or baccate, and bright scarlet at maturity. The base of the spathe is persistent for a time, but the cluster of swelling fruits bursts it, leaving the fruits exposed in a very prominent manner, especially when the scarlet fruit colours up. By this time the leaves have also died away, leaving the stout scape with its scarlet fruits exposed as an attraction to the agents that disseminate the seeds, presumably birds.

The other vegetation in copses and under hedges dies away at the same time as the result of the intensified shade of the leafage of the trees and bushes above them. All the plants thus associated have completed their natural growth, and the principal event in the case of the *Arum* is the dissemination of the seeds.

One of the largest fruits examined contained only two perfect seeds, and two unchanged infertile ovules. Occasionally these seeds are matured. The fruit is 1-celled, and the seeds are basal, or nearly so, erect, and orthotropous. The seeds are globose or obovoid, 4–5 mm. in diameter, and pale yellow. The testa is greatly thickened, and leathery or crustaceous, deeply pitted, with the pits arranged in longitudinal lines. The micropyle is prolonged, forming a mucro, while the base is also prolonged into a short, thick funicle or stalk. In its early stages a thickened arilloid surrounds this short stalk.

A. maculatum is widely distributed in Britain, and on the Continent extends from Gothland to North Africa. On the other hand, *A. italicum* is found only in six southern counties, and on the Continent extends from Holland to North Africa. It would, therefore, seem to be less hardy and to require a higher temperature for its well-being. It has larger fruits and seeds than its relative, and the leaves are sometimes variegated with yellow veins. The leaves are produced in winter, and that alone would tend to restrict its distribution northwards.

Acorus (the Sweet Flag).—The spike contains many hundred flowers. It never, however, produces ripe fruit in Europe, though it does in Asia. It is probable that this is due to the absence of the proper insects for fertilisation. Ludwig suggests that all our European plants are descended from a specimen brought from the East by Clusius. Bentham, however, regards it as native in some of our eastern counties.

Lemnaceæ.—This small family of minute floating or submerged plants consists of two genera and about a dozen species. Both genera and five species are British.

The fruit is a sub-fleshy utricle, indehiscent or dehiscing circumcisely. It contains one to seven erect seeds, which may be either anatropous or orthotropous. The endosperm is fleshy, but sometimes may almost be said to be wanting.

The plants increase principally by budding from the margins of the fronds, and in autumn by bulbils. The flowers are rare, in fact, *L. polyrrhiza*, the largest species, though native in fifty-six botanical districts, has never been known to flower in Britain.

Wolffia arrhiza, again, has never been known to flower in Britain, or indeed, in Europe; the descriptions given are taken from African specimens.

No doubt the plants are disseminated by birds, and of course by currents and floods.

Alismaceæ.—The Alismaceæ are marsh or water plants. In Britain we have six, or perhaps seven genera, some of which are represented by more than three species, but most by only one. The ovary consists of three, six, or many carpels. The fruits differ considerably in form and character. Those of *Alisma* are small achenes. Those of *Sagittaria* are flattened and winged. The fruit of *Damasonium* is a 2-seeded follicle, six of which are usually arranged horizontally in the form of a star. The carpels of *Butomus* (the Flowering Rush) are also beaked, but erect. The seeds are campylotropous, those of *Damasonium* being most completely folded. In *Butomus* they are small, very numerous, anatropous, and scattered all over the inner face of the follicles. The seeds contain a homogeneous mass, generally regarded as being an embryo without albumen. The achenes of *Sagittaria* are flattened and winged. The seeds are shining and not wetted by water, so that they float

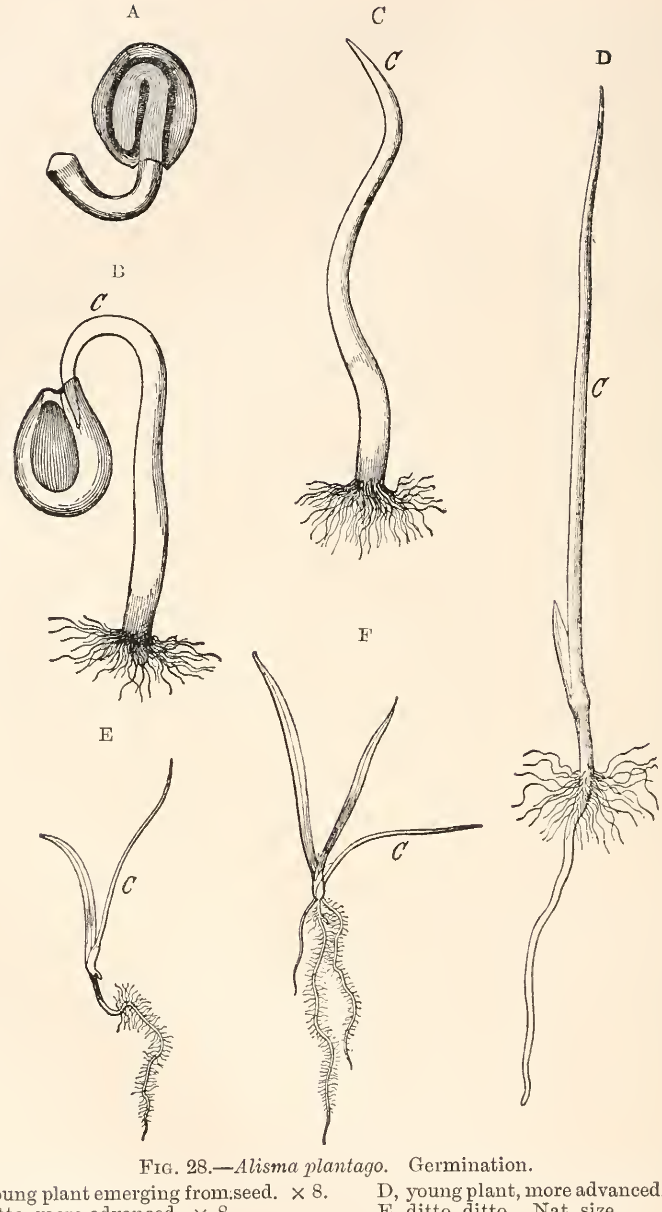

FIG. 28.—*Alisma plantago.* Germination.

A, young plant emerging from seed. × 8.
B, ditto, more advanced. × 8.
C, ditto, free from seed. × 8.
D, young plant, more advanced. × 4.
E, ditto, ditto. Nat. size.
F, ditto, ditto. Nat. size.

c, cotyledon.

(From "Seedlings," pl. 37, p. 44.)

for some time ; in many cases, also, this is promoted by the presence of air-chambers in the cortical parenchyma. Under these circumstances, they must often be carried about by birds.

The seeds of *Alisma* are campylotropous, and ribbed longitudinally with short transverse ridges. I have described the germination in my book on Seedlings. The hypocotyl (fig. 29) is peculiarly thickened. It produces numerous root-hairs from the edge of the thickened extremity. These serve to fix it in the soil or mud. The radicle does not begin to grow for five or six days, and is at first devoid of root-hairs, which, however, after that are copiously developed. The cotyledon is long, linear, or filiform, and at the base sheaths the plumule.

In *Triglochin palustre* (fig. 29) the fruits are sharply pointed, diverging, and turning downwards, being attached by their summits to a stiff erect axis, so that they are easily brushed off by, and run into the fur or skin of, any passing animal.

The seed conforms to the capsule. The elongation of the carpels may serve to prevent them from sinking too deeply—they recall the seeds of *Narthecium* in this respect.

The fruit of *T. maritimum* is oblong, somewhat inflated, acutely 6-ridged, corresponding to the six carpels, and with six deep grooves, one on each carpel.

Fig. 29.—*Triglochin palustre.* After Bentham. (From Bentham's Brit. Flora, p. 800, fig. 963.)

Naiadaceæ.—In this order the carpels are either two or four, each with one ovule. The fruit consists of one, two, or four nuts, generally each with one seed, but sometimes with several. The fruit is generally a nut, but sometimes a berry.

There are sixteen genera and over 100 species; in Britain the order is represented by five genera and about fifteen species. Some authorities, however, consider that *Scheuchzeria* and *Triglochin* belong to this order, rather than to the Alismaceæ.

In *Potamogeton* there are four carpels; the embryo is curved round the seed, which itself is horse-shoe shaped. The outer wall of the fruit is somewhat fleshy, probably sometimes eaten by birds. The plant is somewhat brittle, which no doubt aids in its dissemination. They much resemble the achenes of *Ranunculus,* having a more or less recurved beak.

In *Zannichellia* the fruit consists of two to five free, radiating carpels. Each is curved or slightly reniform, laterally compressed, more or less pedicillate, and terminated by the persistent style, which is half as long as the carpel.

The solitary seed conforms to the interior of the carpel. The embryo is curved. The more or less curved horn would no doubt assist in the dissemination. The plant also, like many other aquatic species, is somewhat brittle.

The fruit of *Naias* is ellipsoid, erect, and terminated by the slender persistent style. One or more are seated in a cup-like cavity formed by stipular sheaths at the base of the leaves, which are opposite, or verticillate. The seeds conform to the interior of the carpel, and the embryo to the seed.

N. marina is almost world-wide.

The pollen of *Phragrostis* is so narrow and elongated that it resembles a filament of a Conferva.

Zostera marina has ribbed seeds; in *Z. nana* they are smooth.

Cyperaceæ (Sedges).—In the Cyperaceæ the ovary is simple, 1-celled and 1-seeded, the perianth being absent, or represented by bristles, three (or multiples of three) in number. The style is divided into two or three stigmas. The fruit is a nut, which is triangular in the species with three styles.

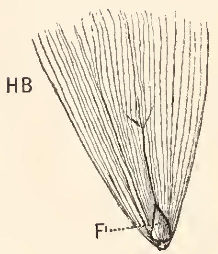

Fig. 30.—*Eriophorum angustifolium* Roth. Nat. size. F, fruit; HB, hypogenous bristles.

The order comprises some 3000 species. Britain has nine genera, and rather more than 100 species, of which about half belong to the genus *Carex* and fifteen to *Scirpus*.

In *Eriophorum* (the Cotton Grass), fig. 30, the bristles reach their maximum. For instance, in *E. vaginatum* var. *polystachyum* (the Common Cotton Grass) they are very numerous, united in bundles at the base, flattened, narrowed to the point, white, with a silky lustre, and often attaining 1–1½ in. in length. They evidently serve for the dissemination of the seeds.

The bristles of *Rhynchospora* and some other genera may serve to entangle the fruits in the fur of any passing animal.

In *Carex* the fruit is inclosed in a bottle-shaped utricle, or bag, enlarged at the base and surmounted by a more or less elongated neck, open only at the top.

The utricle is often swollen, as, for instance, in *C. panicea*, and inflated, which would render the fruits light, and facilitate their dispersal either by wind or water. In some cases, as in *C. leporina*, they are winged.

The long beak which occurs in many species, and is often serrulate, would, like the bristles, serve to entangle the fruits in the fur of any passing animal. The utricles are generally smooth, but in *C. hirta* they are hairy, which perhaps may serve the same purpose.

In *C. pulicaris* the utricle is lanceolate, compressed, shining, and more or less reflexed when mature. This may evidently lead to their being carried off.

GRAMINEÆ (Grasses).—The Gramineæ comprise over 3000 species. They range all over the world, and in stature range from an inch to 80 feet.

The flowers are in spikelets, which are arranged in spikes, racemes, or panicles. Each spikelet consists of (1) one, two, or

FIG. 31.
Wheat: Spikelet.

FIG. 32.
Wheat: Glume.

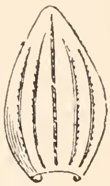

FIG. 33.
Wheat: outer Glumelle.

FIG. 34.
Wheat: inner Glumelle.

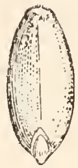

FIG. 35.
Wheat: Caryopsis.

(Figs. 31–5 from Maout and Decaisne's "Descriptive and Analytical Botany.")

more scales or bracts, known as "glumes," arranged alternately on opposite sides of the spikelet, and with their faces towards the axis; (2) of flowering glumes, each inclosing (3) a smaller scale, known as a pale or palea. Inside this palea is (4) the real flower, composed of two minute scales, known as lodicules, three (rarely two or six) stamens, and a 1-celled 1-ovuled ovary, with two more or less feathery styles.

The fruit or grain contains a single seed, consisting of the true seed and the pericarp, sometimes free, at others adhering to the persisting palea. The embryo lies outside of the albumen, which is gradually absorbed by the cotyledon (scutellum). When this is completed, the cotyledon shrivels up and perishes, by which time the young plant, by means of its rootlets and leaves, is in a position to supply itself with nourishment.

Amongst British species there are usually two empty glumes, but in *Panicum*, *Setaria*, *Phalaris*, *Anthoxanthum*, and *Hierochloa*, there are one or two extra empty glumes, but these seem to be flowering glumes reduced, and more or less rudimentary. In *Lolium* there is only one empty glume, except on the terminal spikelet, which has the normal number, two. Empty glumes are altogether absent in *Leersia oryzoides* and *Nardus*, unless a small tooth on one side of the little cavity bearing the spikelet of the latter may be regarded as a glume reduced to the smallest proportions visible.

The empty glumes are usually persistent on the axis after the flowering glumes with their contents fall away, but in *Panicum* and *Setaria* there is a joint below the empty glumes, so that they fall away at maturity. As a rule, the empty glumes are more or less chaffy and large, so as to inclose the rest of the spikelet wholly in the young stage, and wholly or only partly at maturity. The grasses which have only one fertile flower in a spikelet are well covered and protected by the empty glumes, and *Avena*, *Deschampsia*, *Aira*, *Holcus*, *Arrhenatherum*, and *Sieglingia*, are instances where the large, chaffy, empty glumes cover the two to three flowers present.

The flowering glume is mostly rolled round the caryopsis, or fruit, usually contains a smaller organ, known as the pale, and the two inclose and protect the ripe fruit, in many cases being more or less adherent to it. In nearly all cases the caryopsis is inclosed by the glume and pale, when the so-called grain is dressed and spoken of as seed, as in the Oat and Rye-grass. The common, or cultivated wheat (*Triticum sativum*) is a rare exception, the fruit or caryopsis being readily separable from the glumes.

In *Hordeum* (the Barley) the spikelets are in threes, and only one or two contain a perfect flower. The empty glumes are often reduced to mere awns.

In some species one flower has stamens only, and some are always monœcious or diœcious. Sometimes the whole spikelet contains only two glumes, one empty, the other flowering, with or even without a palea. Though the family is very natural, these differences and reductions render it very difficult.

A characteristic feature is the "awn." The midrib of the flowering glumes, or of the intermediate empty ones, or of all the glumes, is prolonged into a bristle which is sometimes very much elongated. It proceeds either from the point of the glume, or from a notch at the top, or in some cases leaves the midrib lower down.

The awns appear to serve several different purposes. In some species they are a protection against birds, and perhaps against other animals; in others they serve for the dissemination, or for the sowing of the seed.

In other cases no doubt the awns serve to catch the wind, and thus move the seed.

Some grasses (*Setaria, Oryza*) have barbed bristles, which no doubt adhere to passing animals. In others the awns serve for this purpose.

In some species the awns are delicately hygroscopic, and so serve to move the seeds along the ground, and finally to bury them, as will be mentioned later on.

In many grasses the glumes are fringed with fine hairs (*Calamagrostis*), and in others they are widened out and thus serve the same purpose. *Briza* (the shaking grasses), and *Melica* may be mentioned as cases in point. They are always scabrid, or barbed, with short, stout ascending points. The empty glumes occasionally bear awns, but in most cases these are confined to the flowering glumes, and remain upon them while being disseminated, and to aid this most important object would seem to be their chief function in the economy of the grasses.

The empty glumes are awned in *Panicum Crus-galli* (one glume) *Phleum pratense, P. alpinum, P. phleoides, Anthoxanthum odoratum* (on a second pair of empty glumes inside the two lower), *A. aristatum* and *Polypogon monspeliensis*.

The flowering glumes are awned in all the species of *Alopecurus, Agrostis setacea, A. canina, Calamagrostis epigeios, C. canescens, Gastridium lendigerum, Apera Spica-venti, A. interrupta, Ammophila* (very short), *Aira caryophyllea, A. praecox, Corynephorus canescens, Deschampsia caespitosa, D. alpina, D. flexuosa, Holcus mollis, H. lanatus, Trisetum flavescens,* all the species of *Avena, Arrhenatherum elatius, Sesleria caerulea, Cynosurus cristatus, C. echinatus, Koeleria gracilis* var. *britannica, Dactylis, Festuca bromoides, F. ovina, F. rubra,* all the species of *Bromus, Brachypodium, Agropyrum caninum, Lolium perenne* var. *multiflorum, Lolium perenne* var. *aristatum, L. temulentum,* and *Nardus*. The awn of *Corynephorus* is of remarkable form, being clavate, bent and bearded above the base. Although *Phragmites* has no awns, the flowering glumes are slender and elongated.

Conclusion.

Having thus rapidly and very imperfectly run through our families of English flowering plants, and incidentally mentioned some others, I may, in conclusion, ask your indulgence while I make some general observations on seeds.

First, then, as regards size. Why are some large and few, and others so very numerous and small ?

If we could imagine a state of things in which every seed grew and attained maturity, it would be sufficient to keep up the number of any given species existing at any time if each plant produced but one or two seeds during its whole life. There is, however, an enormous destruction of seeds. The great majority are eaten by animals, or fail to secure a suitable site for germination; of those which do germinate again, many are crowded out by their fellows. Darwin observed that out of 357 seedlings which came up in a space of 3 ft. by 2 ft., no less than 295 were destroyed by slugs and insects. Now the greater the chance against any given seed reaching a suitable locality and attaining maturity, the larger number of seeds must the plant produce in order to maintain its numbers, and, as a general rule, the smaller will the individual seeds be. On the contrary, the greater the chance that each seed enjoys of arriving at maturity, the smaller the number of seeds that is necessary, and in such cases it is an advantage that the seeds should be large.

Hence parasitic plants generally produce a large number of very small seeds, though there are exceptions, due to other considerations, as, for instance, in the Mistletoe (I believe, indeed, in all the Loranthaceæ), where the seeds are carried away by birds.

Aquatic plants and those living in muddy situations often have small seeds.

For the same reason, perhaps, saprophytes which grow on beds of deep humus often have extremely small seeds. They do not require any large supply of food in themselves, as they have a rich supply close at hand.

It may also be suggested that in species where the conditions are unfavourable to fertilisation those ovules which do develop may attain a large size.

Form of the Seed.—The next point to be considered is the form of the seed. The spherical may perhaps be regarded as the normal form, because a given amount of nutriment may thus be protected with the least expenditure of material for the construction of a protecting skin or shell. There are, however, many other points to be considered.

In some cases the form is determined by the cavity of the fruit which the seed fills. Where the hollow is spherical, and there is a single seed, this is spherical also—as, for instance, in *Acer.* If there are two seeds, each is hemispherical. When there are more, each is angular, as in the Beech. If the seeds are numerous, as in *Delphinium*, they are polygonal, by mutual pressure while still soft and immature.

In the case of marsh and water plants the seeds are sometimes produced at each end. as, for instance, in *Juncus* (fig. 26), *Drosera* (fig. 24), *Hypericum*, *Elodea*, and especially in *Narthecium* (fig. 25). This perhaps is useful as preventing them from sinking too deep into the soft and mossy ground. In others, as, for instance, *Elatine*, though not produced at the ends, the seed is elongated, which perhaps serves the same purpose.

The fruits of water-plants are often lightened by air-filled cavities. The wide dispersal of the Cocoa-nut is greatly due to the air contained in the fibrous coating.

The form is in many cases adapted to secure dispersal. From this point of view seeds may be divided into various classes:—

Seeds or fruits with wings, which are carried by wind.

Seeds or fruits with feathery appendages, carried by wind, and sometimes, as in the Willow, floated by water.

Seeds in capsules which open at the top, the seeds being jerked out by the wind.

Seeds or fruits with hooks, which are carried by animals.

Fruits which are eaten, and the seeds thus carried by animals.

Seeds which are thrown by the plants.

To the first category, viz. those with wings, belong mainly trees, as, for instance, Pines, Firs, Sycamores, Maples, Elms, and Birch; while, though the fruit of the Lime is not itself winged, it is attached to a leafy bract which serves the same purpose. The same is the case with the Hornbeam. In some cases, however, the wing seems intended, by lightening the seed, to enable it to float, as, for instance, in *Spergularia maritima*, *Alyssum maritimum*, etc.

The next class, those with hairy appendages, is very extensive. To it belong the Willows and Tamarisks, many grasses, Bulrushes, Cotton-grass, Willow herbs, Dandelion, Thistles, and many other Composites, etc., and which occur very commonly on shrubs and trees.

In the great family of Umbellifers, as a rule, the "carpophore" splits lengthwise, and the two mericarps, each containing a seed, hang loosely by their upper ends to the two whip-like filaments. The dry plants are very elastic, and sway backwards and forwards in the wind, until at last some strong gust tears the mericarps off and carries them away.

Another large series is that in which the seeds are borne in capsules which open at the top, the seeds being jerked out by the wind, as, for instance, in many Campanulaceæ, Caryophyllaceæ, Juncaceæ, and many others.

In the case of the Poppy the capsule does not open at the top, but immediately below the summit presents a series of little doors, through which, when the plant is swung by the wind, the seeds come out one by one. The little doors are protected from rain by overhanging eaves, and are even said to shut of themselves in wet weather. The genus *Campanula* is also interesting from this point of view, because some species have the capsules pendent, some upright, and those which are upright open at the top, while those which are pendent do so at the base.

In some species the seeds disperse themselves by creeping or hopping along the ground. In those mentioned last year the bristles or projections merely serve to keep the seeds in a favourable position so as to be exposed to the action of wind, as, for instance, in many Composites, *Trifolium stellatum*, etc. In many grasses, however, the awns are hygroscopic, and thus serve to move the seeds, as in the so-called live oats. The awns are bent, and the part below the bend is spirally twisted. The spiral closes up or relaxes according to the amount of moisture in the atmosphere. In *Avena sterilis* two glumes are awned, and the awns twist in opposite directions, so as to cross and press upon one another. Ultimately they part with a sudden jerk, and the whole seed gives a spring.

In other cases the unrolling awn presses against some fixed body, and thus pushes the seed.

Perhaps the most remarkable example is afforded by *Stipa pennata* (fig. 36), a South European and doubtful British species, the structure of which has been described by Vaucher, and more recently, as well as more completely, by Francis Darwin. The actual seed has a sharp point, and stiff, short hairs pointing backwards. The upper end of the seed is produced into a fine twisted corkscrew-like rod, which is followed by a plain cylindrical portion, attached at an angle to the corkscrew, and ending in a long and beautiful feather, the whole being more than a foot in length. The long feather, no doubt, facilitates the dispersion of the seeds by wind; eventually, however, they sink to the ground, which they tend to reach, the seed being the heaviest portion, point downwards. So the seed remains as long as it is dry, but if a shower comes on, or when the dew falls, the spiral unwinds, and if, as is most probable, the surrounding herbage or any other obstacle prevents the feathers from rising, the seed itself is forced down and so driven by degrees into the ground.

In the case of what we generally call fruits, such as the cherry, currant, peach, etc., the seeds are imbedded in a sweet, juicy pulp. In some cases the pulp only is eaten, and the seeds are rejected; in others the seeds also are swallowed, but they pass through uninjured; moreover, small birds often drop the seeds, and occasionally fall victims to hawks, etc., or perish from other accidents, so that the cases are numerous where even digestible seeds have a chance of growing. Some seeds mimic small insects, and are no doubt picked up, and carried some distance before the mistake is discovered, by birds (see, for instance, the Mallows), or even by insects, as in the case of *Melampyrum*.

Some species have two kinds of seeds, one, *Calendula officinalis* (the Marygold of gardeners) has three; the head comprises many seeds on a flat disk, and the outer row or rows are hooked, the next few bullate so as to catch the wind, while the central ones resemble small caterpillars.

Texture.—Another element to be considered is the texture of the surface. It may be smooth, pitted, ribbed, wrinkled, striate, reticulate, tubercled, aculeate, or hairy.

The "stones" in fruits such as peaches, nectarines, etc., are

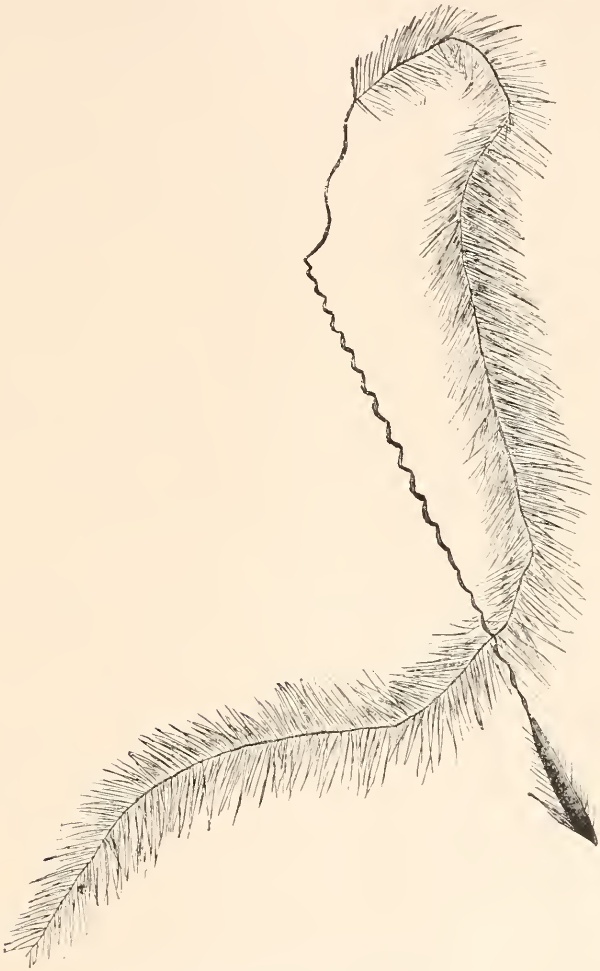

FIG. 36.—Seed of *Stipa pinnata*.

(From "Flowers, Fruits, and Leaves.")

often irregularly roughened, a character which has, perhaps, no significance of utility, but is, so to say, an accidental structure due to the irregular pressure of the cellular tissue on the stone when soft.

I have referred to other cases, as, for instance, that of the Geraniums, in my previous Address.

Hairy seeds have already been mentioned under the head of Dispersal, and the same applies to seeds with spines.

In many cases, perhaps, it may be said that seeds are smooth simply because there is no reason why they should be otherwise. In cases, however, where seeds are thrown, as, for instance, out of capsules, it is an advantage for them to be small, heavy, and perhaps smooth.*

When, however, they are only ejected so as to come under the action of air currents, and the intention is that they should be wafted by the wind, it is an advantage to be large and light. The larger they are, the greater surface is exposed to the current of air: the lighter they are, the longer they will be before they fall. The roughened surface in such cases is also useful in anchoring the seeds to the damp ground.

Protection.—The protection of seeds has been incidentally referred to, but must be directly mentioned. It is of the utmost importance of course to the plant, and all the more as the nutritious property of seeds render them specially tempting to animals, and to vegetable parasites. In many cases, indeed, as in Hazel nuts, Walnuts, Peas, etc., the many are sacrificed to the few—the few being sufficient for the preservation of the race.

Immature seeds and fruits are often protected by hardness or bitterness, by resin or gum. When, on the contrary, they are ripe, and their dispersal is to be effected by animals, they often become sugary and well flavoured, and sweet-scented. When unripe, moreover, they are inconspicuous. In other cases the unripe seeds are protected by thick hard envelopes, as in the Beech and Chestnut, which do not open till the seeds are ripe.

But though the seeds require to be protected by a hard or tough envelope, it must not be too much so. Thus the Beechnut is protected by a fairly strong testa, but not too strong to make them inaccessible to squirrels or mice. On the other hand, in the nearly allied Hornbeam, when the seeds are carried by wind, it would be a loss if any were eaten, and the testa is much harder and stony.

Other characters.—There are, indeed, many other points to be considered with reference to fruits and seeds.

* Since this was delivered, Sir Ralph Payne-Gallwey has contributed to 'The Times' (March 16, 1909) a very interesting series of experiments on the flight of golf-balls. He determined the flight of a perfectly smooth ball, and then found to his surprise that if he nicked the ball slightly with the point of a knife, spacing the small raised nicks about one-third of an inch apart . . . the ball flew splendidly, and about twice as far. He suggests "a ball with slightly raised lines intersecting its surface with spaces between the lines . . . which would somewhat resemble in pattern the network on the outside of a melon." This closely agrees with, and may throw light on, the reticulated surface of so many seeds which are jerked out of a capsule.

Finally comes the question how the young plant emerges from the seed. A dense thick coat is useful to seeds in protecting the embryo from heat and cold, from drought and enemies; on the other hand, if the young plant is to grow, it must be able to emerge at the proper time. The outer coverings of the seed must serve as a castle, but not as a prison. Why are seedling larches so abundant in Switzerland or Siberia, and so rare in England? I throw out the following suggestion: In the high valleys of Switzerland, where the larch is indigenous, there is much snow. All through the winter the seed is soaked in cold snow water, the testa decays, and when the warmth of spring comes the embryo has no difficulty in emerging. In England we have little snow, the seed is comparatively dry throughout the winter, the woody tissue of the testa remains hard and uninjured, and the poor little seedling, unable to escape from its prison, perishes miserably.

In other cases the testa retains its strength, but splits, so that the cotyledons can easily force it open; or is provided with a door through which the cotyledons are able to emerge. In such cases they are narrow and elongated.

In the Water Plantain (*Alisma Plantago*), where the radicle does not at once elongate, the peculiarly thickened hypocotyl produces numerous hair-roots by which the seedling is fixed in the soil or mud. The single awl-shaped cotyledon frees itself by its own growth.

In *Typha* the seed has a sort of trap-door at one end, which is easily pushed open from within by the cotyledon.

In *Trapa* the seed is anchored to the mud at the bottom of the water by diverging pointed processes. The cotyledons are very unequal in size: one is quite small and is carried out of the seed; the other is large and fleshy, serving, in fact, as a reservoir of food. When this has all been absorbed it dies without ever leaving the seed.

The genus *Scabiosa* (the Scabious) affords several interesting illustrations of the devices by which seedlings effect their exit. In *S. australis* the achene closely occupies the interior of the involucel, so that on germination the radicle gets outside immediately and pushes down straight into the soil for a considerable depth, at the same time giving off numerous root-hairs (fig. 37).

If the involucel is fairly well covered with soil, the cotyledons, after the long radicle has established itself, are easily and readily pulled out clear of the seed and its investments. The cotyledons in this species are not very broad, because the seed itself is not very thick.

The base of the hypocotyl has a thickened projecting ledge, which presses against the rim of the involucel and pins it to the earth, while the arching upper part grows upwards and extricates the cotyledons (fig 37.).

In some cases, as was first pointed out by Flahault, for instance, in the Cucumbers, Mimosa, and *Cuphea,* the withdrawal of the cotyledons is facilitated by the development of a projecting lip at the union of the radicle and hypocotyl; this holds down the lower half of the seed-coat, while the continued growth of the hypocotyl forces up the upper half, thus enabling the cotyledons to make their exit.

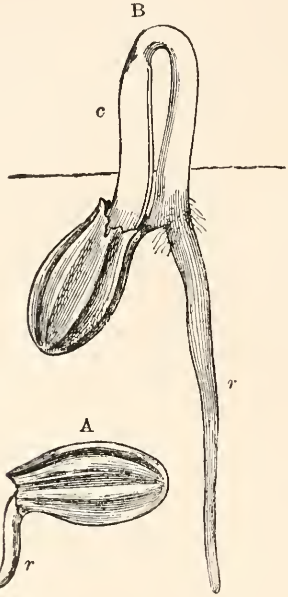

Fig. 37.—*Scabiosa australis.* × 6.
The commencement of germination. In A the radicle (*r*) only has protruded; in B the cotyledons (*c*) are nearly free.

In other cases, as in the Flax, Cress, Chamomile, etc., the seeds are held to the ground by a secretion of mucus or gum.

In *Scabiosa gramuntia* (fig. 38) the fruit is crowned by a well developed cup-like lamina, and the root on leaving the seed curves over in an arch and pins the fruit to the ground, thus enabling the cotyledons to draw themselves out.

In *S. graminifolia* the cup-like lamina has thickened ribs, between which are thinner membranes, which the root can easily pierce.

In *S. palestina* (fig. 39) and *S. atropurpurea* the arrangement is carried still further, and between each two ribs is a perforation, through one of which the radicle finds its way to the ground.

It will be observed that these recent seeds to which I have been calling your attention differ in various ways from those of former

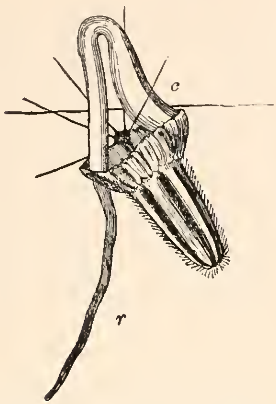

FIG. 38.—*Scabiosa gramuntia* × 4. Germination.
r, radicle; *c*, cotyledon.

FIG. 39.—*Scabiosa palestina.* × 3. Involucel, containing fruit.

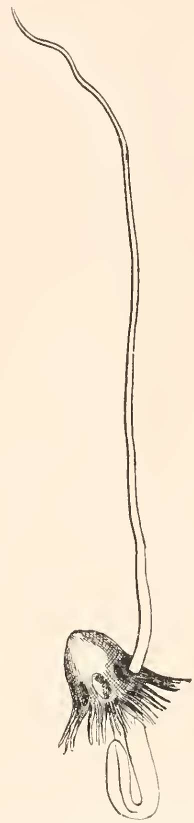

FIG. 40.—*Scabiosa palestina.* × 2. Germination.

(Figs. 38–41 from my work on "Seedlings.")

geological periods, as, for instance, those described in the Address given by my predecessor in the chair. In former periods, for instance, we do not find the same abundance, at any rate, of very small seeds—such as those of Orchids and many parasitic plants; we do not find, so far as I know, seeds with hooks; nor fleshy plants, such as cherries and apples; nor those with parachutes, such as Dandelions and John Go-to-bed-at-noon. Of course it must be admitted that very small seeds, even if they existed in the fossil state, would easily be overlooked. On the other hand, they generally occur in very specialised and no doubt comparatively recent groups, such as Orchids ; or in those of a parasitic character, which also may be regarded as a comparatively late habit.

Seeds and fruits with hooks are evidently adapted for dispersal by sticking to hairs or fur. They would be almost useless in the absence of Mammalia, which were not in existence in Pre-carboniferous, Carboniferous, and even the earlier Secondary strata. They are not suited to the scaly covering of Reptilia.

Fleshy fruits again are specially adapted to birds, which also only commenced in the later Secondary times.

The cases in which seeds are wafted by parachutes again are generally those of highly specialised families. The Composites Onagraceæ, etc., are families dependent on highly organised insects, such as Hymenoptera, Lepidoptera, and Diptera, which also made their appearance only in the later Secondary strata.

It only remains for me in conclusion once more to thank the Society for the honour they have conferred on me in electing me to the Presidency. I must particularly thank the Council for their courtesy and support. Above all I am grateful to the Treasurer and Secretaries, and especially to Dr. Hebb, for their valuable assistance.

I congratulate the Society on having secured Sir E. Ray Lankester as my successor. He is, I need not say, one of the most distinguished naturalists not only of Britain, but in the whole world; and under his able leadership I sincerely trust that the Society will be as useful and as prosperous in the future as it has been in the past.

VIII.—*Some Remarks on a German Silver Powell Portable Microscope, made in* 1850.

By A. A. C. Eliot Merlin.

(*Read February* 17, 1909.)

A few years ago I had the good fortune to acquire a unique and very perfect solid German silver portable Powell stand dated 1850, of the type still produced by that firm. Even from a modern standpoint it is a thoroughly efficient instrument. It is provided with the Turrell mechanical stage, and a rack-and-pinion focusing substage to which centring screws were easily added. This substage carries an achromatic condenser in a German silver mount of precisely the pattern now manufactured and having the same number and description of stops, i.e., a wheel of eleven central diaphragms in addition to dark ground and oblique stops, exactly as figured on page 301 of Carpenter's Microscope (Eighth Edition, 1901). The optical part of the condenser consists of a single front hemispherical lens and two doublet back combinations, the front lens of the middle doublet being concave, as in the 1857 pattern. Its aperture has been measured with Abbe's apertometer and proved to be 0·75 N.A. The initial magnifying power is 46. Used as an objective it stands a solid cone of 0·45 N.A., on the minute species of the blow-fly's proboscis. It yields a solid cone of fully 0·68 N.A., and with it the No. 5 Leitz of 0·74 N.A., will brilliantly dot *P. angulatum*. It is undoubtedly superior to the contemporaneous Gillett condenser which was introduced previously in the same year (1850) and had only 0·65 N.A.

In addition to a micrometer eyepiece, the instrument is provided with three Huyghenian oculars and six objectives. The oculars are respectively of 2·0, 0·96 and 0·495 in. foci, yielding in the 10 in. tube, magnifications of 5, 10·4 and 20·2. The objectives have been carefully measured and tested, with the following results:—

Nominal Foci.	Measured Foci.	Initial Magnifying Power.	Numerical Aperture.	Optical Index.
in. 2	in. 1·64	6·1	0·10	16·4
1	1·00	10·0	0·225	22·5
$\frac{1}{2}$	0·434	23·0	0·392	17·0
$\frac{1}{4}$	0·213	46·9	0·717	15·3
$\frac{1}{8}$	0·1048	95·4	0·895	9·4
$\frac{1}{16}$	0·054	185·4	0·906	4·9

The 2 in. and 1 in. are good working lenses. The $\frac{1}{2}$ in. is probably one of the very finest old objectives ever made. When used with Gifford's screen it will stand a 40 eyepiece and a full illuminating cone without breaking down, and thus arranged it exhibits clean, well-contrasted pictures of various sensitive objects. With the screen and a solid cone of 0·35 N.A., it will completely and cleanly resolve Grayson's 30,000 band. This band is very nearly at the practical working limit of a good apochromat of similar aperture. The $\frac{1}{4}$ and $\frac{1}{8}$ in. will both easily stand the full cone of the old condenser, and with it will clearly dot *P. angulatum* and afford perfectly critical images. The $\frac{1}{16}$ in. has, of course, a very low optical index, but its corrections are remarkably fine, and under it *P. angulatum* shows a strongly contrasted structure, the "dots" appearing so conspicuously black, round, and clearly rendered that one marvels how the "chequered" resolution could have been until so lately considered the proper image, when it is thus evident that lenses and condensers were constructed in 1850, quite as capable of truly picturing this diatom as any dry objectives made to-day. It is manifest that not the instruments, but the men at the eye end were to blame for the uncritical results and the erroneous interpretation of what they saw.

There is another point worthy of notice regarding these old objectives constructed in the very infancy of the modern Microscope, i.e. when the instrument was first furnished with a properly constructed achromatic substage condenser, capable of affording a sufficiently large solid cone to yield truly critical pictures with the highest apertures then available. This is the cleanness of the critical images given by the $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{16}$ in. which will bear moderately deep eye-pieces without breaking up or appearing "rotten." As a matter of fact, they were constructed with a view to standing fairly high oculars, the eye-pieces supplied with them magnifying respectively 5, 10·4, and 20·2, the 10·4 ocular being probably intended for general working purposes. We therefore find that the eye-piece power at present ordinarily employed is about the same as that used on first-class instruments nearly sixty years ago, while the 20 ocular would be considered high by many modern microscopists provided with apochromatic objectives. A modern objective of 0·91 N.A., which with a large cone would bear eye-piecing up to 1850 diameters without exhibiting a fuzzy or pale image, could not be reckoned as anything but good, yet the old nominal $\frac{1}{16}$ in., with the 10 eye-piece, affords a power equal to the above, and the details of objects appear sharp and well contrasted. Of course, it is much easier to obtain good correction with a low than with a high optical index, and it may be safely asserted that sixty years ago no objective of 0·9 N.A. of much less than 90 I.M.P. in a 10-in. tube could have been sufficiently well corrected to produce a clear image magnified up to 2000 diameters by deep eye-piecing, but the $\frac{1}{16}$ in.* attained the mark in a different manner, and thus placed the old workers almost on an equality with their successors of the present day, so far as regards the optical capabilities of dry lenses. It is also a fact that the practical manufacture of a good objective of 0·91 N.A., with such a high initial magnification as 185 requires very great technical skill in consequence of the smallness of its component lenses, and it is doubtless owing to the unrivalled workmanship of Powell that the corrections of these abnormally high power objectives were brought to such a state of perfection as to engender the idea that power *per se* was necessary and the goal to be attained, so that subsequently we find the same firm constructing dry $\frac{1}{25}$ in. and $\frac{1}{50}$ in. objectives of but little higher angle than the $\frac{1}{16}$ in.

With reference to the origin of this once prevalent idea, the writer has very carefully compared the performance of the $\frac{1}{8}$ in. of 0·89 N.A. and the $\frac{1}{16}$ in. of 0·91 N.A., using in both cases the full axial cone of the old condenser. The *P. angulatum* was chosen as a test object, the general strength and quality of the image being taken as a criterion. With merely a signal green glass modifier the performance of the $\frac{1}{8}$ in. proved highly satisfactory, and decidedly better than that of some modern lenses of considerable pretensions which have come under notice as claiming to be very superior and up-to-date productions. On substituting the $\frac{1}{16}$ in., the resolution and quality of the image appeared strengthened, and the general effect was improved more than the slight increase in aperture would warrant.

This gain can only be attributed to the superior correction of the $\frac{1}{16}$ in. over the undoubtedly good $\frac{1}{8}$ in., but one can easily imagine how the old observers were misled by it, and decided, erroneously as we now know, that power *per se* in the objective was an advantage, and the object to be aimed at. Hence the demand by investigators for dry objectives of $\frac{1}{25}$, $\frac{1}{50}$, and even $\frac{1}{80}$ in. foci, all of about similar N.A. to the $\frac{1}{16}$ in., which one would imagine had already a sufficient ratio of power to aperture, and the corrections of which could not be much improved upon owing to the increasing technical difficulties encountered in the construction of smaller combinations. An idea once originated, and generally accepted, is, however, hard to kill, and we consequently find that the envied possessors of the costly $\frac{1}{50}$ and $\frac{1}{80}$ in. objectives were for long fully satisfied regarding their optical efficiency.

* Powell first constructed a $\frac{1}{16}$ in. in 1840.

IX.—*On Synchæta fennica sp. n., and Remarks on the Resting-egg of Synchæta pectinata.*

By Charles F. Rousselet, F.R.M.S.

(*Read March* 17, 1909.)

Plate V.

Since the publication of my monograph of the Genus *Synchæta* in the Journal of this Society in 1902, three new species of this genus have been described, i.e. *S. bicornis* by J. C. Smith,* *S. curvata* by O. T. Lie-Pettersen,† and *S. atlantica* by C. Zelinka.‡ The first was found in 1902, in the brackish water of Lake Pontchartrain, Louisiana, and is remarkable in possessing two dorsal horn-shaped outgrowths of the cuticula. *S. curvata* was found in the Fiords near Bergen, Norway; and *S. atlantica* was collected in mid-Atlantic, to a depth of 400 m., in immense numbers, but only within a well defined area, by the German Plankton Expedition in 1889.

Synchæta fennica sp. n., plate V. figs. 1*a*, 1*b*.

It is now my privilege to describe a fourth new species, *S. fennica*, which I first observed in some marine material sent to me by Dr. K. M. Levander from the Baltic, near Helsingfors, in February 1900, containing *S. baltica* and *S. monopus*. I noticed a small fully-contracted and hammer-headed individual, which I suspected to be a Rotifer, but the nature of which I could not guess. I called Dr. Levander's attention to this animal, but it was a considerable time afterwards when he reported that it was a small *Synchæta*, with two horn-like projections on the head, similar to those of *S. bicornis*, which he found not infrequently in the sea on the coast of Finland. Subsequently Dr. Levander sent a few sketches of details and a few more specimens, and from these Mr. F. R. Dixon-

* *Synchæta bicornis:* a new Rotifer from the Brackish Waters of Lake Pontchartrain. Trans. Amer. Micr. Soc., Sept. 1904, pp. 121–126 (1 pl.).

† Bergens Museums Aarbog, 1905, No. 10, pp. 1–44 (2 pls.).

‡ Die Rotatorien der Plankton-Expedition. Kiel and Leipzig, 1907 (3 pls.).

EXPLANATION OF PLATE V.

Fig. 1*a*.—*Synchæta fennica*. Dorsal view. × 300.
,, 1*b*. ,, ,, Front of head. × 450.
,, 2. ,, *bicornis* Smith. Dorsal view. × 345.
,, 3. ,, *pectinata*. Resting-egg. × 165.

F. R. Dixon-Nuttall del. ad nat.

West, Newman lith.

Synchaeta fennica and Synchaeta bicornis.

Nuttall, with his well-known skill, has made the excellent drawings which accompany this paper, plate V. figs. 1*a* and 1*b*.

The specific characters of this species may be stated as follows:—

Body cylindrical, elongate, curved, tapering posteriorly to a short tubular foot carrying two small toes. Head rounded anteriorly, with well developed auricles, carrying four frontal styles and a frontal tubular antenna, in addition to the usual dorsal antenna above the eye. Eye cervical, single, having the appearance of two appressed halves. Attached dorsally and closely below the ciliary wreath are two stout tubular appendages, directed outward and backward, containing no organs, and being prolongations of the integument and communicating with the body-cavity. The possession of these appendages is very characteristic of this species, and in this respect resembles *S. bicornis*, which has similar horn-like structures somewhat lower down, below the dorsal antenna.

In contraction, when the head is invaginated, the appendages are thrown forward and diverge, producing the hammer-shaped structure at first observed. When fully contracted the cylindrical body is much curved, convex dorsally and concave ventrally, somewhat in the form of a crescent. Two lateral antennæ were detected in the lumbar region, about two-thirds down the side of the body.

The mastax could not be investigated in the few specimens received, but is evidently of the usual *Synchæta* type. Plate V. fig. 1*b*, gives a frontal view of the head.

The rest of the structure appears to be quite normal and requires no further description. The male is not known.

Size: length, 238 μ ($\frac{1}{107}$ in.); width of body below auricles, 68 μ ($\frac{1}{374}$ in.).

Habitat: marine, in the Bay of Bothnia, near Helsingfors.

Synchæta bicornis Smith, plate V. fig. 2.

The figure which Mr. J. C. Smith has given of this species is so diagrammatic in character, that I take this opportunity to reproduce a drawing which Mr. Dixon-Nuttall has made from some well-preserved specimens sent to me by Mr. Smith. Plate V. fig. 2.

From this sketch it will be seen that the horn-like appendages are situated dorsally, just below the dorsal antennæ, and are curved forward. This species possesses three eyes, the two frontal eyes being connected by red granules with the cervical eye, as in *S. triophthalma* and *S. littoralis*. In size it is somewhat smaller, but in the curvature of the body it has considerable resemblance with *S. fennica*.

Size: length 210 μ ($\frac{1}{120}$ in.).

Resting-egg of Synchæta pectinata.

In my description of this species in 1902 I mentioned that no fertilised resting-egg, indicating the presence of a male, had yet been seen by any observer.

This has since been found in 1903 by Dr. St. Hlava, of Prag, who was good enough to send me a female containing an undoubted resting-egg, and in June last year I found a similar egg within the body cavity of a female. It is spherical in shape, the surface covered with short rounded projections as figured in plate V. fig. 3, and yellowish-brown in colour.

The size is $100\,\mu$ ($\frac{1}{250}$ in.) in diameter.

Though the female is very abundant at all seasons, and has been observed for years by many, the male has so far still eluded detection.

Dr. Wesenberg-Lund has in his recent great Plankton work * expressed the opinion that *Synchæta pectinata*, *tremula*, *oblonga*, *stylata*, and *grandis* are only seasonal variations of one species. I think I ought to take this opportunity to express my dissent from this view, as being quite opposed to my experience of these species.

S. pectinata, *tremula*, and *oblonga* are common forms, which appear, disappear, and reappear all the year round (just like Polyarthra, Triarthra, and other Rotifers), and are not uncommonly all present together at the same time. In the Grand Junction Canal, running on the north side of London, where I frequently collect, these three species were all present in great abundance, with some half-a-dozen other species of Rotifers, at the end of December, and *S. pectinata* and *oblonga* still persist at the present time (March), whilst *S. tremula* has temporarily disappeared.

S. pectinata is very rarely absent from this canal, and it is certainly there in spring, summer, autumn, and winter, without any appreciable difference in size. Further, these various species have distinctive organs, their lateral antennæ are in different positions, and, above all, they have different types of jaws. Thus it is not merely a question of size or elongation of the body; whilst the seasonal variation, which has been demonstrated in the case of *Asplanchna priodonta*, consists of a lengthening of the body only during the summer months. A further consideration is, that of all Plankton Rotifers the *Synchæta* are the most vigorous swimmers, and quite able to counteract by their cilia any slight tendency to sink that may be due to a decrease in the density and viscosity of the water in summer.

* Plankton Investigations of the Danish Lakes, Copenhagen, 1908.

S. stylata and *grandis* are rare forms; the first I have occasionally, whilst the latter I have never, found in the canal. The periodic and often very sudden, disappearance and reappearance of various Rotifers is a well known fact, and the *Synchæta* follow the same habits.

I am quite prepared to admit that in large lakes there may exist some seasonal variation in the direction of elongation of body or increase in length of spines in some species, not, however, in effecting such structural and organic changes which would convert a *Synchæta oblonga* into *S. pectinata* and that species into *S. stylata* or *S. grandis.*

OBITUARY.

Jean Alfred Nachet. 1831–1908.

Plate VI.

Jean Alfred Nachet was born at Paris in 1831. In 1853 he joined his father in the business, their attention being at first occupied by the construction of binocular Microscopes * which had just been introduced by Professor Riddell of New Orleans. Next they brought out demonstration Microscopes † which had two, three or four bodies, so that more than one observer might view the same object through the same Microscope at the same time; later, in 1860, an etching prism was brought out.‡

This firm's well-known Camera Lucida was designed by M. Nachet, senior, in 1843, but it underwent alteration and improvement in 1882 § and again in 1886.|| There is an article about cameras from the pen of J. A. Nachet in Quart. Journ. Micr. Sci., viii. (1860) p. 156.

In 1877 he brought out a dark-ground illuminator,¶ a variety of spot lens; and in the same year he made a large inverted Microscope,** with the object-glass below the stage, the rays being bent upwards into an inclined tube by a first-surface mirror; the ray-path being 3 ft. long. These tubes were of great size, in fact they might have belonged to a small astronomical telescope. The idea of this Microscope was to obtain both a large amplification and field by means of great tube-length; the tube was doubled up to bring the focusing and various other adjustments within reach of the observer.

In 1880–1 Nachet made some petrological †† (called petrographical) Microscopes. In 1881 a spring changing nose-piece,‡‡ and in 1882–5 some portable §§ Microscopes were introduced by that firm. In 1885 he made a class Microscope |||| in which all the adjustments and movable parts could be locked up by a key. In the next year ¶¶ we have his "Grand Modèle Perfectionné." A novelty is claimed for this instrument inasmuch as the fine-adjustment,

* Quart. Journ. Micr. Sci., ii. (1854) p. 72, figs. 1–4. † Loc. cit.
‡ Op. cit., viii. (1860) p. 206, 1 fig.
§ See this Journal, 1882, p. 260, figs. 44–6.
|| Op. cit., 1886, p. 1057, fig. 228.
¶ Op. cit., 1877, p. 463, fig. 103. ** Op. cit., 1879, p. 766, fig. 1.
†† Op. cit., 1880, p. 228, fig. 15; 1881, p. 934, figs. 205–6.
‡‡ Op. cit., 1881, p. 661, figs. 144–5.
§§ See this Journal, 1882, p. 99, figs. 7–11; 1885, p. 700, figs. 137–8.
|||| Op. cit., 1885, p. 514, fig. 100. ¶¶ Op. cit., 1886, p. 837, fig. 157.

A. NACHET.

which is of the ordinary Continental direct-acting screw type, has the action of its compensating spring reversed, i.e. it acts downwards instead of upwards; but, what is more important, a feature, now quite common, is seen in the substage, which is of the swing-out, screw-focusing, and centring type. This requires an explanation. At first the Abbe condenser was fitted by Zeiss merely with a push-focusing slide, without centring gear; but there was in addition a cylinder diaphragm, fitted both with rackwork focusing and centring gear on a swing-out arm. This plan was reversed by Reichert,* who placed the cylinder diaphragm in a slide and the condenser in the swing-out arm with a spiral-focusing screw; he however suppressed the centring gear, and centred the movement in the nominal axis by a pin. M. Nachet followed Reichert's improvement, mounting his condenser in a spiral-screw focusing swing-out arm, but by retaining the centring gear he has the priority for this very useful appliance for students' cheap Microscopes.

Notwithstanding the interest he took in all that concerned the Microscope, he found time to pay attention to other branches of optics, especially that connected with ophthalmology. All this time his scientific knowledge and his great practical skill were always at the service of those who required aid for any special and difficult work: indeed it was owing to this energy and complaisance that he participated in so many and so various researches.

In 1899 he retired from business, and this retirement allowed him leisure to prosecute his scientific researches, to gather together numerous notes concerning the past history of the Microscope, notes which he had collected little by little, relating to interesting models; and also to form a library of rare books on the same subject.

Brought up among savants, a contemporary of others in whose works he had shared, having assisted in the scientific evolution of nineteenth century, it may easily be imagined that the remarkable memory with which he was endowed was an inexhaustible mine of interesting remembrances. Alfred Nachet became a Fellow in 1879, and in 1906 presented to the Society one of its most valuable and interesting possessions, namely, six Micro-Daguerreotypes taken with the Electric Light by Léon Foucault in 1844. The letter which accompanied the donation is dated January 14, 1906, and is recorded in the Proceedings, pp. 122–3, of the Society's Journal for 1906.

* See this Journal, ser. 2, vol. iv. (1884) p. 438, fig. 53. The swing-out arm was suggested by the swing-out arm which carries the polariser in a petrological Microscope.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Russo's attempt to show Differentiation of Sex in Ovarian Ova of Rabbit.‡—Walter Heape directs attention to Russo's recent work, in which he seeks to show: (1) that by means of the introduction of lecithin into the doe rabbit he can profoundly modify the proportion of the sexes produced by her; and (2) that he can thereby also demonstrate histologically two kinds of ovarian ova, "male" and "female" ova. It seems that of the two "male" ova figured by Russo, one is in a degenerating follicle and the other in a state like an early phase of degeneration. Heape is forced to deny the cogency of Russo's alleged demonstration, but he is strongly of opinion that the quality or quantity of food supplied to the mother, and her individual capacity for assimilating food and transmitting nutriment to the ovary, under varying conditions of metabolism, are factors of importance in determining the proportion of the sexes ultimately produced by all animals in which only a limited number of their ovarian ova come to maturity.

Sex of Pheasant Hybrids.§—Michael F. Guyer finds that in a total of sixty-one hybrids of Phasianidæ which he studied in museums, the sex was not noted in ten cases, it was male in forty-seven, and female in four (of which three were hybrids of very closely related species). He suggests that the predominance of males may be somehow due to defective nutritive conditions associated with the incompatibility in two germ-plasms which are too dissimilar.

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Proc. Cambridge Phil. Soc., xiv. (1908) pp. 609–12.

§ C.R. Soc. Biol. Paris, lxv. (1908) pp. 642–4.

Columella auris in Amphibia.*—B. F. Kingsbury and H. D. Reed find that in Urodela at least there are two distinct structures in the sound-transmitting apparatus. The first is the columella arising independently and connected primarily with the squamosal, and in some forms secondarily with the quadrate cartilage. It is probably homologous with the hyomandibular-symplectic of fishes. The second is the operculum which seems to arise from a differentiated portion of the ear capsule itself.

Electric Stimulation and Parthenogenesis†.—Yves Delage has tried to discover how the electricity acts in inducing the parthenogenesis of the eggs of the sea-urchin contained in a fluid through which a current passes. It seems at present difficult to say whether the result should be attributed to the action of static charges or to electrolysis produced by the current.

c. General.

Mammalian Migrations in Tertiary Times.‡—W. D. Matthew considers Depéret's conclusions as to Tertiary migrations, and states his own. These may be summarised [|| = separation ; ←→ = union permitting intermigration ; ? = doubtful]—

Middle Oligocene	N. America || Asia ←→ Europe ? Africa.
Lower Oligocene	N. America ←→ Asia ←→ Europe ? Africa.
Upper Eocene	N. America || Asia ←→ Europe || Asia ←→ Africa.
Middle Eocene	N. America || Asia ←→ Europe || Africa.
Lower Eocene	N. America ←→ Asia ←→ Europe || Africa.
Basal Eocene	Asia || N. America ←→ Europe || Africa.

This is, of course, only a working hypothesis. In brief, it is that Asia is and has been the great centre of evolution and dispersion of the dominant mammalian types ; in the other continents, the course of evolution has been—aside from a few well-known exceptions—alternately an autochthonic faunal development and a series of waves of migration from the highly progressive faunas of the great Asiatic land mass, according as the continents were separated from or connected with it. The principal exceptions are the Proboscidea, of African origin ; the true Edentates of South American development and doubtful origin ; the Camels, of North American origin ; probably other groups, if we knew something about the fauna of the early Tertiary in Asia.

Structure of Colobus.§—Clara Polak gives a careful account of the structure of the Guereza, and compares it with that of other monkeys. The position of the genus is beside *Semnopithecus* in the sub-family Semnopithecinæ. It is a type intermediate between the lower and the higher Catarrhini.

* Anatomical Record, ii. (1908) pp. 81–91 (7 figs.).
† Comptes Rendus, cxlvii. (1908) pp. 1372–8.
‡ Amer. Journ. Sci., xxv. (1908) pp. 68–70.
§ Verh. k. Akad. Wet. Amsterdam. xiv. (1908) x. and 247 pp. (57 figs.).

Eyes of Chrysochloris.*—Georgina Sweet publishes a study of the *Chrysochloris hottentota* and *C. asiatica*. The eyes of the two forms agree in almost all details. The eye has sunk only into the dermis, and is surrounded by the hair-roots. The conjunctival sac is well developed, and also generally the lachrymal gland, the duct of which opens into the sac. From the sac in most cases a cylindrical tube leads to the exterior, but from its direction it can be of no use as a path for light-rays giving rise to vision. The eye muscles are quite absent. Sclerotic lens and choroid are represented by the fibrous schlerochoroid. Lens and iris are very degenerate though quite recognisable. The vitreous humour is absent. The pigment layer of the retina is thick posteriorly, and absent anteriorly. The retinal layers are, in most cases, clearly distinguishable, very little degeneration being apparent in the outer ones. The layer of rods and cones is more or less distinct. The optic nerve was found in the adult specimens examined, though the ganglion cell layer is the most degenerate part of the retina.

As regards the position, the eye in *Chrysochloris* is not, even after the hair is shaved, generally visible from the exterior, as it is in *Scalops* and *Talpa*, but it is comparatively superficial in contrast to that of *Rhineura* and *Notoryctes*. The eye of *Chrysochloris* as a whole is distinctly more degenerate than that of *Talpa* or *Scalops*, but very much less so than that of *Notoryctes*. It is without doubt of no use for vision, and it is improbable that even degrees of light can be detected by it. The gland secretion can only have its usual function of keeping the conjunctival cavity free from foreign matter.

Variations in Hyla aurea.†—Georgina Sweet records a number of variations in this Australian frog, e.g. a vestigial arch between the systemic and the pulmo-cutaneous; looping of the veins (dividing and re-uniting), especially in the mandibular, external jugular, and femoral veins; indications that the sacral plexus is moving forwards; fusion and distortion of vertebræ; and so on.

Hybrid Newts.‡—Heinrich Poll artificially fertilised the ova of *Triton cristatus* Laur. and *T. vulgaris* L., and conversely. A large number of ova began to develop, but most died in early stages. Only a few became fully formed larvæ, a hybrid of *T. vulgaris* ♂ and *T. cristatus* ♀, and seven of the converse crossing. A hybrid which accomplished the metamorphosis showed a striking mixture of paternal and maternal qualities, and some resemblance to *T. vittatus*. It may be recalled that *T. blasii* de l'Isle was shown by Wolterstorff to be the hybrid of *T. cristatus* and *T. marmoratus*.

Thymus of Teleosteans.§—J. A. Hammar publishes a study of the thymus gland in Teleosteans. For his investigation he used many stages of eleven different species, and single specimens of other nine forms. Almost all the specimens were freshly caught. In his account

* Quart. Journ. Micr. Sci., liii. (1909) pp. 327–38 (1 pl.).
† Proc. Roy. Soc. Victoria, xxi. (1908) pp. 349–64 (2 pls., 9 figs.).
‡ Biol. Centralbl., xxix. (1909) pp. 30–31.
§ Arch. Mikr. Anat., xxxvii. (1908) pp. 1–68 (2 pls., 10 figs.).

of the structure of the adult organ, and its histogenesis, he gives full details of the conditions in the different forms. Other sections deal with myoid cells, age-involution, and accidental involution. Each section begins with a consideration of the literature relating to it. The general results of the investigation, which, the author considers, may throw light on some cardinal points in the general morphology and physiology of the organ, are summarised as follows. The fact that the Teleostean thymus is, not only in its early stages but throughout life, in the greater number of the forms examined, an integral part of the surface-epithelium of the gill-cavity, demonstrates the epithelial origin and constitution of the thymus reticulum, both as regards core and cortex. The downward growth found in some forms, and the relatively late separation from the epithelium, which was found in one form (*Cyprinus*), is of interest as showing a transition to the conditions found in other Vertebrates. The freedom of the thymus-rudiment from vessels, and the simple form of its boundary adjacent to the connective tissue, make it easy to determine the passing of numerous lymphocytes through the boundary-surface during the differentiation of the organ. Exact measurements and calculations showed that this passage of the lymphocytes is to be interpreted as an immigration, not an emigration. The theory of the autocthonous origin of the thymus lymphocytes is apparently irreconcilable with the state of things found in the Teleostean thymus.

The occasional occurrence of myoid cells in the placoid Teleostean thymus, before it has been invaded by blood-vessels or connective-tissue, excludes the possibility that these cells have been either brought in or shut in. The occurrence of transverse striped fibrillæ in the typical reticulum cells also points to an autocthonous origin of the myoid cells.

An involution of the thymus takes place in Teleosteans, under essentially the same forms as it occurs in the higher Vertebrates. It is probable that in this case also there is a relation between sexual maturity and age-involution. Withdrawal of nourishment gives rise to accidental involution of the thymus in Teleosteans in the same way as in other Vertebrates.

Eels and their Migrations.*—W. L. Bishop gives an account of some observations and experiments on eels, with special reference to the season of their migration, and the length of time they can remain out of water. He was led to these observations by the fact that in the waterworks of Dartmouth, Halifax, eels caused considerable trouble by continually getting into the water-mains, and blocking up the service-pipes to the town. Men were constantly employed in digging up these pipes in September and October, and from thirty to fifty eels were taken from the pipes each year in those months. The pipes to the town were the only outflow from the lake at that season. A trap was arranged at the gate-house to the water-supply, and a varying number of eels were taken every day, the highest figure reached being 308, on August 26. All the relatively high numbers occurred after heavy rainfall.

The eels taken in May and June were invariably of small size, and

* Proc. and Trans. Nova Scotia Inst. Sci., xi. (1906) pp. 640–50.

had apparently just come from the sea. To test this point, a trap was set in these months the following year in the outflow. This trap had its opening facing down-stream, to intercept eels coming up from the sea, and in eight days it contained eighty-nine small eels of the same size as those taken in the gate-house trap the previous year. The take in the gate-house trap decreased in proportion, but the author remarks that it remains to be seen whether the entire absence from the lake of eels, which are excellent scavengers, may not affect the water prejudicially.

To test their capacity for living without water, a number of eels were put into a box in a room at a temperature of 56° F. Two put back into the water after twenty-two hours became quite active at once, and the rest seemed in the same condition. The largest lived for forty-three hours. Experiments made later in the season showed that eels fifteen to eighteen inches in length can do without water longer than small ones. One of these lived for seventy-two hours. Eels move easily through wet grass, and "it is probable that they can travel overland for considerable distances, should occasion require it."

Char of Great Britain.*—C. Tate Regan discusses the British species of *Salvelinus*. Four have been hitherto recognised—*S. killinensis* from Loch Killin, *S. struanensis* from Loch Rannoch, *S. willughbii* from Windermere, *S. perisii* from Llanberis. To these are added five new species—*S. gracillimus* from Girlsta, Shetland, *S. inframundus* from Hellyal Lake, Hoy Island, Orkneys (1862), *S. maxillaris* from a loch near Ben Hope, Sutherlandshire, *S. mallochi* from Loch Scourie, Sutherlandshire, *S. lonsdalii* from Haweswater.

Tunicata.

Phosphorescence of Pyrosoma.†—Charles Julin finds that isolated ovarian ova and isolated embryos are phosphorescent. The luminosity has two distinct and consecutive seats—in the first place, in the "testa-cells," and, in the second place, in the lateral glands of the four primary ascidiozooids. The "testa-cells" or kalymmocytes have no share in forming the embryo; they are not absorbed by the blastomeres. Their structure is the same as that of the elements in the lateral glands, and they cause phosphorescence in the cyathozooid.

INVERTEBRATA.

Mollusca.

δ. Lamellibranchiata.

Branchial Eyes of Bivalves.‡—Paul Pelseneer called attention in 1899 to the presence of a minute eye at the base of the most anterior filament of the internal plate of the gill in some Mytilidæ and in *Avicula*. He has since found it in about thirty species. It is a distinct eye with a pigmented retina and a cubicular crystalline lens. Perhaps the light comes through a translucent triangular zone near the

* Ann. Nat. Hist., iii. (1909) pp. 111–22 (4 figs.).
† C.R. Soc. Biol. Paris, lxvi. (1909) pp. 80–2.
‡ Bull. Classe Sci. Acad. Belg., Nos. 9–10 (1908) pp. 773–9.

hinge. The eye occurs in *Mytilus*, *Modiola*, *Lithodomus*, *Modiolaria*, *Septifer*, *Avicula*, *Malleus*, *Meleagrina*, *Anomia*, *Pinna*. There are usually two, one on each side, but in *Anomia* and *Meleagrina* there is only one, on the left,—the upturned side. This suggests that the eye still functions, and its absence in the abyssal Mytilid *Dacrydium* is also noteworthy. Pelseneer finds in the peculiarity of *Anomia* and *Meleagrina*, evidence of Lamarckian factors in evolution, but the argument is not clear.

Arthropoda.

a. Insecta.

Vestigial Organs in Larval Muscids.*—J. Pantel notes that the "tronçon intermédiaire" of the dorsal vessel is in reality a series of three to four pairs of rudimentary cardiac chambers, and that there are rudimentary stigmata on segments iv–xi, and dorsal communicating tracheæ in segments iii and xii. All these are vestigial structures.

Pædogenesis of Cecidomyids.†—W. Kahle has studied the development of the proliferating *Miastor*-larvæ. It is genuine parthenogenesis. There is only one maturation-division, and it is an equation-division. The polar body divides into two, which show the beginnings of another mitosis. At the 8-cell stage there is a definite separation of soma and germ-lineage, the latter being started by the cell at the posterior pole. Its "polar plasm" is preformed in the immature ovum. In the 4-cell stage there is a diminution-process in the three somatic nuclei, and it goes on in the seven somatic nuclei of the next stage. There is a halving of the chromosomes; in the germ-cell lineage there are 20–24, in the reduced nuclei there are 10–11. The blastoderm is established at the 58-cell stage, and 8 "urogonia" or primitive germ-cells lie at the hind end of the blastoderm. Yolk-cells are formed by immigration from the blastoderm. The eight urogonia come to lie in the eleventh segment, where they multiply to form the ovary. The nutritive cells of the ovarian follicles come from the mesoderm. In the dorsally curved germinal streak stage there are hints of cœlom-sacs. The mid-gut is formed from the proximal ends of the fore-gut and hind-gut.

Froth in Spittle-Insects.‡—Braxton H. Guilbeau has made a careful study of the formation of the froth in *Aphrophora parallela*, *Lepyronia quadrangularis*, and *Clastoptera proteus*, and finds that the secretion is made up from two sources. The fluid portion is the anal secretion into which the insect, by means of its caudal appendages, introduces numerous air-bubbles. The glands of Batelli, situated in the pleural region of the seventh and eighth abdominal somites, secrete a mucilaginous substance which, added to the anal fluid, renders it viscous and thus causes the retention of the air-bubbles. The so-called branchial appendages of Morse and of Porta are merely plates of this mucilaginous secretion.

* Comptes Rendus, cxlviii. (1909) pp. 107–10 (1 fig.).
† Zoologica, lv. (1908) pp. 1–80 (6 pls. and 38 figs.).
‡ Amer. Nat., xlii. (1908) pp. 783–98 (8 figs.).

Development of Parasitic Hymenoptera.*—F. Silvestri gives an account of the development of *Ageniaspis fuscicollis* Dalm., *Encyrtus aphidivorus* Mayr, and *Oophthora semblidis*. We cannot do more than refer to a few points. In the first the ovum gives origin to ten to fifteen embryos, and part of the ovum form a trophamnion; there are two polar bodies in the parthenogenetic as well as in the fertilised ova. In the second, as in the first, unfertilised ova develop into males; the parthenogenetic as well as the fertilised ova form two polar bodies; the egg develops into a single embryo.

Myrmecophilus Wingless Fly.† — Günther Enderlein describes *Oniscomyia dorni* g. et sp. n., a new Phorid found by Karl Dorn, in Bavaria, in a colony of *Polyergus rufescens*. Among its distinctive features the following may be noted: the maxillary palp is reduced to a knob, and has only a few minute setæ; there is no proboscis; the limbs are relatively short, with very minute claws; there are no wings or ocelli. The author distinguishes this new type from *Platyphora* Verr., *Ænigmatistes* Shelf., *Ænigmatias* Mein., and *Thaumatoxena* Bredd. and Börn, and he also distinguishes a new genus *Termitodeipnus*, with an unsegmented abdomen, from *Thaumatoxena*, which has two segments. The other four genera have six abdominal segments. All the six genera are nearly related, and should be ranked in a sub-family Platyphorinæ which the author defines.

Mites on Mosquitoes.‡—L. Bruyant finds that many mosquitoes carry about larval mites belonging to the genera *Midea* (or *Mideopsis*), *Hydrochoreutes* (or *Lebertia*), *Curvipes*, and *Diplodontus*.

Economic Entomology.§—Robert Newstead gives an account of the gum-lac insect of Madagascar (*Gascardia madagascariensis*), which is closely related to *Ceroplastes*, but possesses no characters in common with the lac-producing members of the Tachardiinæ. He also deals with *Lecanium nicotianæ* sp. n. and other tobacco-infesting insects, and various other forms.

Primitive Insects.‖—F. Silvestri continues his studies of Thysanura, and deals with some new Projapygidæ including a new genus *Symphylurinus*. To the Acerentomidæ (Protura) he adds *Eosentomon wheeleri* sp. n., and makes a new genus *Proturentomon* for *Acerentomon minimum* Berlese.

Proboscis of Blow-Fly.¶—W. Wesché discusses this familiar object from an evolutionary standpoint. He concludes that *Calliphora* is one of the later, though not specialised genera of Muscidæ. Genera with specialised proboscis have diverged at different times from the more generalised Muscid stock, and this chronological order is suggested—*Drymia*, *Stomoxys*, *Hæmotobia*, *Siphona*, *Prosena*, *Glossina*.

* Boll. Lab. Zool. Scuola Sup. Agric. Portici, iii. (1908) pp. 29–83, (2 pls. 62 figs.).
† Zool. Jahrb., xxvii. (1908) pp. 145–56 (1 pl. and 1 fig.).
‡ C.R. Soc. Biol. Paris, lxv. (1908) pp. 706–7.
§ Quart. Journ. Liverpool Inst. Commercial Research, iii. (1908) pp. 3–13 (19 figs.).
‖ Rend. R. Acad. Lincei Roma, xviii. (1909) pp. 7–10.
¶ Journ. Quekett Micr. Club, (Nov. 1908) pp. 283–94 (2 pls.).

Crystals of the Cockroach's Egg-shell.*—P. Hallez points out that the crystals which form a mosaic on the ootheca of the cockroach are quadratic octahedra of oxalate of lime (not carbonate as Bordas supposed).

Genital Apparatus of Female Cockroach.†—L. Bordas describes in *Periplaneta orientalis* the seminal receptacle or spermotheca, which consists of two unequal tubes, which unite for a short distance proximally, but have distinct orifices between the eighth and ninth abdominal sternite. Two accessory or arborescent glands, also unequal, must not be confused with spermothecæ. The larger one secretes abundant octahedral crystals, and helps to form the ootheca. The other is different in structure and function. The opening of these glands is on the ninth abdominal sternite. None of these organs—spermothecæ or arborescent glands—has any connection with the oviduct or the uterus.

Myrmecophana fallax Brunner.‡—J. Vosseler finds that this form is a young stage of the Phanopterid genus *Eurycorypha*. The larvæ of two (perhaps of all) species of *Eurycorypha* pass through a creeping stage and six jumping stages, with considerable changes in appearance and behaviour. In the first three jumping stages they are like ants; in the two last stages they are like leaves of plants. The colouring in the leaf-like stages is in part due to the food. The phrase "transformative mimicry" is applied to the remarkable resemblance first to ant and then to leaf.

Flies in Amber.§—F. Meunier has studied over 300 specimens of Phoridæ and Leptidæ in Baltic amber. They are very closely allied to modern Palæarctic species, though none of the amber species can be said to survive now. There has not been much evolution in these Diptera since the Tertiary times began.

γ. Myriopoda.

New Littoral Millipede.‖—K. W. Verhoeff describes *Isobates adriaticus* sp. n., for which and for *Isobates littoralis* Silv. he establishes a new subgenus *Thalassisobates*. He found this new millipede on the Croatian shore, and he shows that it is in certain respects specially adapted for its unusual habitat, e.g. in having very long claws on the appendages, probably for holding on by.

δ. Arachnida.

British Spiders.¶—Frank P. Smith calls attention to the need of a revised monograph of British spiders. He gives a number of records

* Comptes Rendus, cxlviii. (1909) pp. 317–18.
† Op. cit., cxlvii. (1908) pp. 1415–18.
‡ Zool. Jahrb., xxvii. (1908) pp. 157–210 (1 pl. and 13 figs.).
§ Comptes Rendus, cxlvii. (1908) pp. 1362–3.
‖ Zool. Anzeig., xxxii. (1908) pp. 486–95 (11 figs.).
¶ Journ. Quekett Micr. Club, Nov. 1908, pp. 311–34 (1 pl.).

of occurrence, and establishes the new genus *Lessertia*, which he distinguishes from the nearly allied *Leptorhoptrum* Kulcz and *Tmeticus* Menge.

New Marine Spider.*—Louis Fage describes *Desidiopsis racovitzai* g. et sp. n., found by Racovitza among the calcareous algæ on the Mediterranean shore. It is related to *Desis* in the sub-family Cybœinæ. It lives in burrows of *Lithodomus*, in empty shells of *Vermetus*, or in crevices, and its web varies with the situation. Numerous threads across the mouth of the hole help to keep the water out. It can remain for a long time under water, the abdomen surrounded by an envelope of air; it can creep about, but has to hold firmly else it would rise to the surface; unlike *Argyroneta* it cannot swim. It probably lives on small Diptera and mites.

Scottish Hydrachnids.†—W. Williamson discusses early papers by Johnston (1848) which seem to be the earliest British records of Hydrachnids. Johnston describes three species: *Hydrachna cruenta* Müll. (Johnston) [= *Diplodontus despiciens* (Müll.)]; *Atax histrionicus* [= *Limnesia histrionica* (Herm.)], and *Hydrachna naïca* Johnston [= *Hygrobates reticulatus* P. Kram., = *Hygrobates naïcus* Johnston].

Hydrachna.‡—C. D. Soar discusses this genus, and gives a very useful table for the preliminary identification of British species. He recognises twenty-one of these, fourteen previously recorded, three new to the British fauna, and four new to science. Many probably remain to be discovered, for few districts in the British Isles have been systematically worked.

ε. Crustacea.

Variation in Palæmonetes varians.§—Arthur Brožek has made a biometrical study of this Decapod from four localities—Lago de Castello, Italy (fresh water); Montenegro, two lakes (fresh water); and Plymouth (brackish water). Like previous workers on this subject, he devotes special attention to the rostral teeth.

Blood-forming Organs in Cumacea.‖—L. Bruntz has found in *Iphinoe tenella* G. O. Sars, a pair of dorsal lymphoid organs forming blood corpuscles. They lie in the anterior portion of the fifth thoracic ring. Thus the Cumacea are no exception to the distribution of these organs in higher Crustacea. Only in Leptostraca do they seem to be absent.

Abnormal Oviducts in Lobster.¶—W. G. Ridewood describes a specimen of *Homarus vulgaris*, which had a normal oviducal opening on the right side, and two on the left—on the fifth leg (where the vas deferens of the male normally opens) and on the fourth leg. The

* Arch. Zool. Expér., ix. (1908) Notes et Revue No. 4 pp. lxxv–lxxxiv. (9 figs.).
† Ann. Scot. Nat. Hist., Jan. 1909, pp. 27–30 (1 fig.).
‡ Journ. Quekett Micr. Club, Nov. 1908, pp. 271–82, (1 pl.).
§ S.B. k. Bohm. Ges., 1907 (published 1908) No. xvi. pp. 1–27 (1 pl.).
‖ Arch. Zool. Exper, ix. (1909) Notes et Revue, No. 4, pp. lxv.–ix. (2 figs.).
¶ Ann. Nat. Hist., iii. (1909) pp. 1–7 (2 figs.).

duct on the left to the last leg was like a normal oviduct; the duct to the penultimate leg could not be traced in its entirety (as the liver had exerted a digestive action on the internal portion). The author gives an account of somewhat similar abnormalities in other Crustaceans.

New Crab from Telegraph Cable in Indian Ocean.*—W. T. Calman describes *Calocarcinus africanus* g. et sp. n. found on the telegraph-cable between Aden and Zanzibar, depth about 600 fathoms. It belongs to the family Xanthidæ, and approaches closely to *Sphenomerides* Rathbun (*Sphenomerus* Wood-Mason), though differing from it in several important characters.

Body Spaces and so-called Excretory Organs of Ibla quadrivalvis.†—Freda Bage distinguishes the more or less irregular spaces of the hæmocœle, and a glandular organ, opening into a large saccular bladder, which communicates with the exterior by a duct opening at the base of the second maxilla. The glandular organ is probably excretory, and the equivalent of a maxillary gland or of the coxal glands of *Limulus*.

Mutation in Atyidæ.‡—Edmond Bordage has inquired, at Bouvier's suggestion, into the relation of *Atya serrata* and *Ortmannia alluaudi*, which occur together in mountain streams in Bourbon. The genera differ in several ways, e.g. in the form of the chelæ on the two anterior thoracic limbs. Bordage found that the females of *Ortmannia alluaudi* may give rise to young of the *Ortmannia* type and to young of the *Atya* type. Out of sixteen eggs, ten became the former and six the latter; the larval stages were externally the same, but the eggs were different, and the post-larval forms were different.

New and Rare Entomostraca from Scottish Seas.§—Thomas Scott reports some interesting forms collected by the 'Goldseeker' in Scottish Seas—*Xanthocalanus tenuiremis* sp. n., *Amallophora claviger* sp. n., *Pseudotharybis zetlandicus* g. et sp. n. (near *Tharybis*), and *Euchonchœcia d'arcy-thompsoni* sp. n.

Traces of Autotomy in a Fossil.‖—R. Legendre notes that all the specimens of *Callianassa faujasi* in the palæontological collection in the Museum of Natural History in Paris, are represented simply by the claws, and he infers from this that autotomy was as common among Crustaceans of the Secondary ages as it is now.

Annulata.

Nephridia of Phascolion.¶—L. A. Moltchanoff gives an account of the atrophied left nephridium and the developed right nephridium of *Phascolion spitzbergense*. The latter consists of a tube bent on itself, with the walls fused where they touch. The external orifice is just opposite the internal opening; the upper and the lower canal of the

* Ann. Nat. Hist., iii. (1909) pp. 30–33 (1 fig.).
† Proc. R. Soc. Victoria, xxi. (1908) pp. 226–32 (1 pl.).
‡ Comptes Rendus, cxlvii. (1908) pp. 1418–20 (2 figs.).
§ Ann. Nat. Hist., iii. (1909) pp. 122–30 (3 pls.).
‖ C.R. Soc. Biol. Paris, lxv. (1908) pp. 662–3.
¶ Bull. Acad. Imp. Sci. St. Pétersbourg, ser. 6, i. (1909) pp. 69–74 (5 figs.).

tube communicate at the free end. The upper canal seems to correspond to the mesodermic funnel, and the nephridium belongs to the type of metanephridia seen in Polychæts. The nephridia of the adult are developed from those of the larva.

Stolons of Syllids.*—Aug. Michel describes several different types of stolons: (1) acephalous, in *Syllis cirropunctata* sp. n.; (2) "tetraglène," where the head is represented only by two biocular tubercles, in *Trypanosyllis zebra*; (3) "dicère," where the head bears biocular tubercles and a pair of lateral antennæ, in *S. vittata*; (4) "tetracère," where the head is almost complete, with eyes, lateral antennæ, and palps, in *S. amica*.

Syllis vivipara.†—Aug. Michel discusses this interesting species. It is viviparous, and neither male nor spermatozoon is known. It is by no means common, but fourteen specimens (all females) were collected near shore between the Naples Zoological Station and the port of Mergellina. Almost all had the second part of the body more or less distended with larvæ, with 10–20 setigerous rings when they pass out. Neither Goodrich or Michel found any trace of hermaphroditism.

Atlantic Palolo.‡—A. G. Mayer describes the breeding-swarm of the Atlantic palolo, *Eunice fucata*. In habits it is quite similar to the palolo of the Pacific, *E. viridis*, but while the Pacific form swarms on or near the day of the last quarter of the moon in October and November, the Atlantic form swarms within three days of the last quarter of the moon, between June 29 and July 28. The annual swarming has been observed only at Tortugas, Florida.

The Atlantic palolo lives within crevices of dead coral, or limestone beach-rock. The worm is usually coiled backward on itself or twisted within the cavity. The sexual products are confined to the 150 posterior segments, which are swollen by the contained eggs or sperms. Before sunrise on the day of the breeding-swarm, the worm crawls out backwards from its burrow till all the sexual segments and part of the middle of the body protrude. A vigorous corkscrew-like movement begins in the sexual segments, which soon break off from the middle of the body and rise vertically to the surface. When the first rays of light fall on the sea, the worm begins to contract violently, the sexual products are cast out through rents and tears in the dermo-muscular wall, and the shrivelled cuticula sinks to the bottom.

Experiments were made with a view to determining the nature of the stimulus to which the Atlantic palolo responds when it swarms. It was found that a mechanical shock would often cause the worm to cast off its genital products, but even if this took place within 24 hours of the normal swarming period, the eggs did not develop. In partially stagnant water the worms may live, but they will not swarm. Worms were kept in floating tanks in which circulation was secured by numerous holes. A proportion of these worms swarmed normally within three days of the usual time. But none swarmed when moonlight was excluded.

* Comptes Rendus, cxlviii. (1909) pp. 318–20.
† Op. cit., cxlvii. (1908) pp. 1423–5.
‡ Publication, Carnegie Inst. Washington, No. 102 (1908) pp. 105–12 (1 pl.).

New Echiuroid.*—I. Ikeda describes *Hamingia ijimai* sp. n. from a 500-fathom basin in the Sagami Bay. The females differ from those of *H. arctica* in the structure of the anal glands, the number of the main canals (three on each side), the arrangement of the funnels, and so on. The males are characterised by the absence of ventral hooks, the degenerate intestine, and the extremely long sperm-reservoir.

Nematohelminthes.

Excretory System of Echinorhynchus gigas.† — A. Schepotieff describes two "protonephridia"—hollow lobed vesicles—lying one on each side of the anterior part of the uterus. They consist of four parts: a stalk, a few (15) main branches, very numerous (400) branches of the second and third order, and terminal expansions which do not open into the body-cavity. The terminal parts are ciliated, an exception to the statement that Nematohelminths have no cilia. Schepotieff compares the excretory organs of *Echinorhynchus gigas* with those of Priapulids: there is a resemblance in form, position, and relations to the genital organs.

Sexual Phenomena in Free-living Nematodes.‡—F. A. Potts has corroborated some of Maupas' observations on *Rhabditis* and *Diplogaster*. In the case of an hermaphrodite species of *Diplogaster*, there are supplemental males, structurally perfect, with abundant spermatozoa, which seem to have lost their sexual instinct. These useless forms occur in small but fluctuating numbers. Artificial conditions made no difference on the number. The species under observation multiplied by self-fertilisation for a year, but exhibited no signs of degeneration at the end of that period.

Classification of Strongylidæ.§—A. Railliet and A. Henry discuss this difficult problem. The sub-family Metastrongylinæ is defined off from Ankylostominæ. The Metastrongylinæ include the following: *Metastrongylus*, *Dictyocaulus*, *Synthetocaulus*, *Crenosoma*, *Hæmostrongylus*, *Hæmonchus*, *Graphidium* g. n., *Trichostrongylus*, *Cooperia*, *Ostertagia*, *Nematodirus*, *Histiostrongylus*, *Heligmosomum*, g. n. Definitions of the new genera are given.

Platyhelminthes.

Regeneration in Planarian.‖—P. Steinmann made a median longitudinal cut into the anterior end of a decapitated Planarian, and two heads were formed. When the same was done posteriorly, two tails were formed. When the anterior incision was shallow, the two heads were small, each being about the size of half a normal head. When the longitudinal cut was carried far back, the new heads were of the usual size. The regeneration is influenced by the inter-relations of parts.

* Annot. Zool. Japon, vii. (1908) pp. 61–8 (1 pl.).
† Zool. Jahrb., xxvi. (1908) pp. 293–304 (1 pl. and 2 figs.).
‡ Proc. Cambridge Phil. Soc., xiv. (1908) pp. 373–5.
§ C.R. Soc. Biol. Paris, lxvi. (1908) pp. 85–8.
‖ Arch. Sci. Phys. Nat. xxvi. (1908) pp. 552–3.

Movements of Convoluta.*—H. Piéron has been led by his observations to conclude that the rising of *Convoluta* to the surface of the sand, and its descent again, and the time it remains up when it comes up, depend on the environmental influences of light, moisture, pressure, and the shocks of the waves. There is no need to assume an hereditary rhythm.

Paravortex scrobiculariæ Wahl.†—Paul Hallez gives a description of this Turbellarian which lives in the stomach, intestine and pyloric cæcum of *Scrobicularia piperata*, and is specifically quite distinct from *P. cardii*, which Hallez recently reported from the cockle.

Trematode in Hibernating Gland of Hedgehog.‡—M. Athias describes what seems to be a species of *Distomum*, which he found in making sections of the hibernating gland of the hedgehog. He has not been able to determine the species.

Structure of Sterrhurus fusiformis Lühe.§—K. Miestinger gives an account of this Trematode which he obtained, along with *Lecithochirium rufoviride* (Rud.) from the duodenum of a conger. He describes the genital system, the food-canal, the excretory organs, the nervous system, the parenchyma, and the cuticle.

Hymenolepis farciminalis.‖—T. B. Rosseter describes this tapeworm, hitherto referred to the genus *Tænia*. It has been found in the alimentary tract of the crow, starling, jay, and jackdaw. The ripe joints have a somewhat sausage-like shape, as the specific name indicates. The elongated filiform medianly constricted seminal vesicle is characteristic, and so is the long, slender vaginal canal.

Larval Ligula in Cranial Cavity of Tench.¶—Maurice Neveu-Lemaire reports the occurrence of a larval stage of *Ligula simplicissima* in an unusual place, the cranial cavity of a tench.

Incertæ Sedis.

Review of Actinotrocha.**—Franz Poche maintains that the name *Phoronis* must yield to *Actinotrocha*. Dura lex, sed lex. He proposes a class Actinotrochoidea, an order Actinotrochidea, a family Actinotrochidæ, all for the genus *Actinotrocha* J. Müller, otherwise known as *Phoronis*. He then takes a survey of the recorded forms, and finds that there are thirty-one species on the list. Of these, however, twenty-one are known only as larvæ.

Remarkable Epithelium in Bryozoa.††—F. Henneguy calls attention to the unique epithelium found in the œsophageal region of Bryozoa, e.g. in *Alcyonidium hirsutum* and *Bugula alveolata*. The œsophageal

* C.R. Soc. Biol. Paris, lxv. (1908) pp. 673–5.
† Arch Zool. Expér., ix. (1908) Notes et Revue, No. 4, pp. lxxii.–v.
‡ Arch. R. Inst. Bacteriol. Camara Pestana, ii. (1908) pp. 133–45 (2 pls., 7 figs.).
§ Arbeit. Zool. Inst. Univ. Wien, xvii. (1909) pp. 359–84 (2 pls.).
‖ Journ. Quekett Micr. Club, Nov., 1908, pp. 295–310 (1 pl.).
¶ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 88–9.
** Arch. f. Naturges, lxxiv. (1908) pp. 372–88.
†† Comptes Rendus, cxlviii. (1909) pp. 134–8 (4 figs.).

epithelial cells, which are continuous with the ciliated cells of the pharynx, bear numerous striated muscular fibrils on their walls—an adaptation to their mechanical function of trituration.

Rotifera.

Seasonal Variation in Plankton Rotifera.* — Amongst other plankton organisms dealt with by Wesenberg-Lund in his monumental work are the Rotifers, in particular *Asplanchna priodonta*, *Synchæta*, *Polyarthra*, *Anuræa*, and others. The author's results have satisfied him that most plankton Rotifers show a seasonal variation more or less pronounced in response to stimuli due to variations in temperature. These stimuli are a change in the specific gravity of the water and in its viscosity, resulting in an increased rate of sinking at higher temperatures. In response to these stimuli some Rotifers appear to increase the size, and in particular the length of their bodies, whilst others increase the size of their spines or produce protuberances or spines, calculated to counteract the rate of sinking. With regard to *Asplanchna priodonta*, the author gives tables of measurements showing that in large lakes this species steadily increases in size from May to July, and then rather suddenly disappears. No one will doubt such results, but when the author contends that the small *Synchæta oblonga* changes into the large *S. pectinata* and larger *S. grandis*, both widely different in anatomical structure, it is to be feared that few students of the Rotifera will be able to follow him.

Rotatorian Fauna of Boston.†—C. F. Rousselet gives a list of forty species of Rotifera collected by him in the lake of the Central Park, in Boston (Mass.), U.S.A., one of which, *Notholca bostoniensis*, is described as new. Besides its small size, it differs from *N. longispina* in having only four anterior spines instead of six, and by the fact that the long anterior spine is on the left of the median line instead of on the right.

Echinoderma.

Echinoderms of the Coasts of Spain.‡—F. Aranda y Millan gives an annotated list of twenty-five Asteroids, eight Ophiuroids, nineteen Echinoids, eighteen Holothuroids, and two Crinoids.

Genus Linthia in Victoria.§—G. B. Pritchard describes a large new species (*L. mooraboolensis*) of this extinct sea-urchin from Eocene limestone beds in Victoria. The specimen figured was over 7½ in. in its greatest diameter. Three other species are discussed, including *Linthia gigas* McCoy, formerly referred by mistake to the genus *Pericosmus*.

Cœlentera.

Rhythms in Sea-Anemones.‖ — H. Piéron has studied *Actinia equina* in order to discover whether there are definite periodicities in

* Plankton Investigations of the Danish Lakes. Copenhagen, 1908.
† Journ. Quekett Micr. Club, ser. 2, x. (1908) pp. 335–40 (2 pls.).
‡ Mem. R. Soc. Españ. Hist. Nat., v. (1908) pp. 215–55 (5 pls.).
§ Proc. R. Soc. Victoria, xxi. (1908) pp. 392–400 (2 pls.).
‖ C.R. Soc. Biol. Paris, lxv. (1908) pp. 726–8.

its life. There was no evidence of correspondence between the behaviour of the sea-anemone and the tides. There is often alternation of rest and activity, but without any regularity.

Opening and Closing of Sea-Anemones.*—H. Piéron finds that *Actinia equina* closes up when there is a diminution of oxygen in the medium. It closes when the tide goes out as an adaptation to a medium with a variable and often low supply of oxygen. The closing increases its power of resisting asphyxia.

Developmental Cycles of a Scyphistoma.†—E. Hérouard describes a Scyphistoma in the aquarium at Roscoff, which he has called *Tæniolhydra*, though it is apparently a peculiar phase of some known genus. For four years it has formed cysts, each containing a blastula, which develops into a polypoid embryo with two tentacles. No ephyræ were formed in four years, but when Hérouard fed the Scyphistoma with sea-urchin ovary they budded off ephyræ. During the four years without ephyræ the animal had insufficient food, and simply budded off polypoid stages like itself, or formed statoblasts with blastulæ as already noted.

Pulsation in Medusæ.‡—A. G. Mayer has studied the rhythmical pulsations of *Cassiopea xamachana*. Sea-water is a balanced fluid, neither inhibiting nor stimulating pulsation. This is due to the fact that the sodium chloride of the sea-water is a powerful nervous and muscular stimulant, but the magnesium, calcium and potassium are inhibitors. The sea-water itself being indifferent, permits any weak, constantly present, internal stimulus, to produce the nervous responses which cause rhythmical pulsation of the muscles.

The stimulus which causes pulsation, is due to the constant formation of sodium oxalate in the terminal endodermal cells of the marginal sense-organs. This sodium oxalate precipitates calcium, as calcium oxalate, thus setting free sodium chloride and sulphate, which act as nervous stimulants. Pulsation is thus caused by the constant maintenance at the nervous centres in the sense-organs of a slight excess of sodium over and above that found in the surrounding sea-water.

If we cut a strip of heart tissue, or of subumbrella tissue of a medusa in such a manner as to give it the shape of a ring or of any closed circuit, and then start a contraction-wave moving in any one direction through this circuit, the wave will continue to travel at a uniform rate around the circuit. This wave will maintain itself indefinitely, provided the circuit be long enough to permit each and every point in the path of the wave to remain at rest for a certain period of time before the return of the wave through the circuit. No one localised point on the circuit acts as a dominant centre for maintaining the wave, but all points on the path of the wave take an equal share in passing the wave onward to points beyond them. In nature the structure of pulsating organs, and their manner of stimulation, are

* Comptes Rendus, cxlvii. (1908) pp. 1407–10.
† Op. cit., cxlviii. (1909) pp. 320–3 (1 fig.).
‡ Publications, Carnegie Inst. Washington, No. 102 (1908) pp. 113-31 (13 figs.).

designed especially to prevent such a circuit-wave from taking possession of the organ.

In *Cassiopea* the pulsation-stimulus is conducted by the diffuse network of the subumbrella, and is independent of the muscles, which may or may not respond to its presence by contraction. In other words, conductivity of the pulsating tissue is independent of its contractility.

A solution containing the amounts and proportions of $NaCl + KCl + CaCl_2$ found in sea-water, produces strong primary nervous and muscular excitement in *Cassiopea* (and in *Lepas*), followed by exhaustion and muscular tetanus. This may be cured by adding the amount and proportion of magnesium found in sea-water.

New Primnoids.*—Kumao Kinoshita describes two new Primnoids, for which he proposes to establish a new subgenus of *Thouarella*. The diagnosis of this new subgenus, *Diplocalyptra*, reads: Colony small; branching typically dichotomous; without secondary twigs, in one plane; axes yellow to brown, with a gold sheen; polyps in whorls of 2 to 4, rarely solitary; operculum inconspicuous, but a strong circum-operculum; sclerites thin.

New Plexaurids.†—W. Kükenthal reports a number of new Plexaurids—seven species of *Euplexaura*, six of *Plexauroides*, *Anthoplexaura dimorpha* g. et sp. n., and three new species of *Eunicella*. The new genus, *Anthoplexaura*, is thus defined: Colony with bushy branching in several planes; polyps large, without spicules, retractile into prominent calyces; dimorphic, with very numerous siphonozooids; cœnenchyma thick, with spindles and clubs which bear broad, often forked warts; the axis is horny, impregnated with lime, and very delicate towards the ends of the branches. This very remarkable form was obtained from Sagamai Bay.

British Museum Sertulariidæ.‡—A. Billard agrees with Hartlaub that *Sertularella cuneata* Allm. and *S. crassipes* Allm. are the same, and are also identical with *S. arborea* Kirchenp. As Hartlaub thought, *S. capillaris* Allm. is the same as *S. johnstoni* Gray. There is a peculiar form of *Sertularia elongata* Lamx. that may perhaps be a case of sexual dimorphism. There is no difference between *S. crinis* Allm. and *S. operculata* Linné, or between *S. amplectens* Allm., *Desmoscyphus gracilis* Allm. (= *Sertularia versluysi* Nutting), and *S. loculosa*, or between *S. crinoidea* Allm. and *S. minima* Thomps., or between *S. unilateralis* Allm. and *S. bispinosa* Gray, or between *Thuiaria persocialis* Allm., *T. articulata* Pallas, *T. ellisii* Busk, or between *T. dolichocarpa* Allm., *T. zelandica* Gray, and *T. hippisleyana* Allm.

Porifera.

Neptune's Cup.§—E. Topsent calls attention to Vosmaer's discovery that this sponge, *Poterion patera* (formerly *P. neptuni*, etc.), is some-

* Ann. Zool. Japon. vii. (1908) pp. 49–60 (6 figs.).
† Zool. Anzeig., xxxii. (1908) pp 495–504.
‡ Comptes Rendus, cxlviii. (1909) pp. 193–5.
§ Arch. Zool. Expér. ix. (1909) Notes et Revue, No. 4, pp. lxix.–lxxii.

times a borer in shells. The huge cup is the free form of a boring sponge. Analogous cases are known, e.g. *Cliona celata*. Topsent thinks that the sponge should now be called *Cliona patera*, and that the name *Poterion* should be suppressed.

Protozoa.

Observations on Acinetaria.*—C. H. Martin gives an account of his observations on Acinetaria. He first discusses the "Tinctin-Körper" of Plate, and suggests that under this name chromatin granules which may originate in one of three distinct ways are confused, (1) from the ingested nucleus of the prey; (2) from the degenerating macro-nucleus after conjugation; and (3) possibly to a very slight extent in some cases from fragments of the macro-nucleus thrown out in connection with the formation of a digestive ferment. The first of these ways is by far the most common, since conjugating Acinetaria are relatively rare. But these bodies are only distinguishable when the details of the past life of the individual are known, so that the general name is necessary.

The various stages of conjugation in *Acineta papillifera* were studied, and the process was found to agree in all essentials with that occurring in the ciliate Infusoria, and that described by Hickson for *Dendrocometes paradoxus*. It is possible that in those cases in which a fixed form cannot come into contact with another mature individual, a reorganisation of the nuclei may be effected, associated with either (1) conjugation with a free-swimming ciliate bud, or (2) a process of parthenogenesis associated with the formation of the so-called "external buds" of Keppen.

The second part of the paper deals with the life-cycle of *Tachyblaston ephelotensis* g. et sp. n., found by the author in the Bay of Naples in May 1908. In its fully developed stalked form the animal resembles very closely a form which was described many years ago by Robin, and has not since been seen, *Acinetopsis rara*. The author considers it probable that this form is only a stage in the life-history of *Tachyblaston ephelotensis*.

In regard to systematic position, *Tachyblaston* is apparently closely related to *Urnulina*, and not in any way to the parasitic *Sphærophrya* described by Metchnikoff. Its position is quite indeterminable from the parasitic stages of its development, but it shows characteristic features in its later, free-living stages. It is of special interest as showing the beginning of a complicated life-cycle in association with a parasitic method of life, in a group of Protozoa which are characteristically free-living, or at any rate external parasites. Starting from the *Acinetopsis* form, we have free-living tentaculate buds, which, passing into their host, give rise, by a process of division, to ciliated spores of large size, and these in turn develop on fixation into the *Acinetopsis* form again.

New Ciliated Infusorian.†— E. Poyarkoff describes *Cepedella hepatica* g. et sp. n., a parasite in the liver of *Sphærium corneum*, a

* Quart. Journ. Micr. Sci., liii. (1909) pp. 351–87 (2 pls.).
† C.R. Soc. Biol. Paris, lxvi. (1909) pp. 96–7.

common Cyclad. It is an astomatous form, with straight rows of long cilia, with a sharp anterior end and a rounded posterior end. It has a special fixing apparatus, a sort of sucker, at the anterior end. The micronucleus is relatively large. The parasitism is intimate, and sometimes intracellular.

Hæmogregarina splendens.*—C. França discusses the parasite of the frog's blood known as *Hæmogregarina splendens* Labbé (= *Dactylosoma splendens* Labbé, *Laverania ranarum* Grassi and Feletti). He devotes special attention to the binucleate condition, and to the resemblance between *H. splendens* and Trypanosomes.

New Hæmogregarine from a Lizard.†—A. Laveran and Salimbeni describe a new parasite (*Hæmogregarina tupinambis* sp. n.) of the red blood corpuscles of *Tupinambis teguixin*. It enters the corpuscles and brings about interesting changes—e.g., hypertrophy of the nucleus—before destroying them.

Hæmogregarina lacertæ.‡—A. Laveran and A. Pettit discuss the occurrence of two kinds of merozoite-cysts of this parasite in the lizard. That is to say, the endogenous multiplication in cysts seems to occur in two forms, cysts with macromerozoites and cysts with micromerozoites. It seems probable that the merozoites are not always formed in the same way; the karyosome may divide into four or eight, or it may go on dividing into more numerous and smaller merozoites. It is probable, but quite unproved, that part of the life-history is passed in a tick.

Trypanosome in Zanzibar Horse.§—A. Edington notes that hitherto no trypanosomiasis has been recorded from Zanzibar or Pemba. He has found a case, however, in a horse. The trypanosome somewhat resembles *T. dimorphon*, but is smaller and rather more delicate.

Sexual Reproduction in Actinocephalidæ.‖—P. Léger and O. Duboscq find in these Gregarines a sexual process like that in *Stylorhynchus*. Two similar forms of the same size unite by their protomerites; the male has a denser, more stainable, cytoplasm; there is in both a precocious differentiation of somatic nuclei and sexual nuclei; there is anisogamy with male flagellate elements (of two kinds) and globular female elements; the gametes have a short mobile phase and unite as in *Stylorhynchus*; the result of the union becomes a spherical spore, and exhibits nuclear multiplication.

* Arch. R. Inst. Bacteriol. Camara Pestana, ii. (1908) pp. 123–31 (12 figs., 1 pl.).
† Comptes Rendus, cxlviii. (1909) pp. 132–4 (7 figs.).
‡ Op. cit., cxlvii. (1908) pp. 1378–82 (7 figs.).
§ Proc. Roy. Soc., Series B, lxxx. (1908) pp. 545–9.
‖ Comptes Rendus, cxlviii. (1909) pp. 190–3.

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Structure and Development.

Vegetative.

Structure of Aloë dichotoma.*—L. Lindinger has examined the structure of *Aloë dichotoma*, and finds that there is no distinction between primary and secondary meristem, but that secondary growth takes place in a double zone, consisting of one layer of thin-walled cells having large cavities and a second layer of thick-walled, lignified, narrow cells. Both zones are traversed by bundles. The cork-cells have a strong tertiary layer of thickening. Growth in length takes place in relation to a change in direction of the secondary growth in thickness in the radial cells. The roots have no power of secondary growth. A more general application of results shows that many of the Liliifloræ have power of secondary growth in their stems, and that primary meristem develops without interruption into secondary meristem. Monocotyledons, as a group, spring from tree-like forms possessing power of secondary growth, and the possession of this power by certain of the modern Monocotyledons, may be regarded as a mark of great antiquity. The development of aerial stems, such as are found in the Pandanaceæ, Velloziaceæ, and in different Palms and Bamboos is a reversion to the ancestral type.

Anatomy of Dioon edule.†—R. Thiessen has studied the vascular anatomy of *Dioon*, and finds that the protostele of the embyro becomes a siphonostele in the seedling, and the four protoxylem groups pass down to form the protoxylem of the root. Each cotyledon contains four vascular strands in direct connection with the protoxylem groups. Each leaf has four vascular strands, the two central ones being derived directly and without branching from the main cylinder, while the outer ones are formed by outgrowths which arise upon the opposite side of the cylinder, curve round the stem in opposite directions, and so enter the leaf. The cotyledonary strands are at first endarc, but gradually become mesarc and finally exarc, during their upward course. The same change is seen in the vascular strands of the leaf. Much of the centrifugal wood in the lower part of the foliar strands is primary xylem. A girdle is formed at an early stage, and is always horizontal.

* Bot. Centralbl., xxiv. (1908) pp. 211–53 (4 pls.).
† Bot. Gaz., xlvi. (1908) pp. 357–80 (9 pls.).

Reproductive.

Reproductive Organs of Phyllocladus alpinus.*—N. J. Kildahl has studied the morphology of the reproductive organs of *Phyllocladus*, and finds that the microsporophyll has two sporangia which shed the microspores about November. There are two prothallial cells, of which only one is usually persistent. The ripe microspore has usually four nuclei. The ovulate cone bears two to eight ovules, each with two integuments, one thick and fleshy and the other thin and leathery. The integuments are free and have no vascular strands. Numerous pollen tubes pass straight through the nucellus to the archegonia, and discharge their entire contents into the egg-cells; just before discharge the body-cell divides into two equal male cells, only one of which is functional. A heavy jacket-layer of multinucleate cells surrounds the archegonium; there are probably two neck-cells. The pro-embryo contains at least eight free nuclei before the formation of cell-walls; there is a long suspensor.

Embryo-sac of Peperomia.†—W. H. Brown has examined the embryo-sac of four species of *Peperomia*, and finds that a single hypodermal cell cuts off a parietal cell and then forms the embryo-sac. The nucleus of the latter undergoes heterotypic division and then goes into synapsis; then follows longitudinal splitting of a continuous spirem, and the chromosomes are formed from loops in the spirem. The chromosomes may undergo a second division through the longitudinal split of the first division In the last division of the embyro-sac nucleus, cell-walls are formed on the spindles which cut off one of each of the eight pairs of nuclei, while those remaining free fuse to form the endosperm nucleus. Six of the inclosed nuclei degenerate, while the egg and a nucleus occupying the position of a synergid persist. There are sixteen nuclei in the mature sac apparently derived from four megaspores, but there is not sufficient evidence to justify "the conception of four megaspores in an embryo-sac to all Angiosperms in which a row of megaspores is not formed," since some divisions may be omitted or the order transposed.

Embryology of the Podostemaceæ.‡—F. A. F. C. Went has investigated the development of the ovule, embryo-sac and egg in the Podostemaceæ. A complete series of development was obtained for *Oenone Imthurnii* and *Mourera fluviatilis*, while other species were less fully studied. Results show that the development differs widely from that of the ordinary Angiosperm, but within the limits of the order is very uniform. The chief points of difference are as follows:—The inner integument develops after the outer one and never extends as far as the top of the nucellus. By the stretching and disintegration of certain cells in the lower part of the nucellus, a pseudo-embryo-sac is formed. This phenomenon seems to prove the existence of causes acting in the ovule, favouring the formation of a large cavity which

* Bot. Gaz., xlvi. (1908) pp. 339–48 (3 pls.).
† Tom. cit., pp. 445–60 (3 pls.).
‡ Proc. Akad. Amsterdam, x. 2 (1908) pp. 824–32.

functions as an embryo-sac when the true embryo-sac does not develop. The true embryo-sac has no antipodal cells and no antipodal polar nucleus; it undergoes little development after the formation of the egg-apparatus, so that no endosperm is formed. The development favours the view that "the egg-apparatus of the higher plants is a reduced archegonium."

Physiology.

Nutrition and Growth.

Rise in Temperature of Foliage-leaves.*—H. Molisch has carried out experiments upon *Carpinus Betulus*, *Salix Capræa*, *Cytisus Laburnum*, *Abies excelsa*, *Solanum tuberosum*, *Brassica*, etc., with the view of investigating the causes which produce rise in temperature in living, freshly plucked leaves. Leaves of Monocotyledons, evergreens, and similar plants show very little increase in temperature; tubers and such fruits as those of *Pirus communis* behave in the same way. Generally, however, freshly plucked leaves when heaped together and protected from draughts and excessive transpiration behave similarly to buds and germinating seeds with respect to increase of temperature. Such leaves quickly reach a maximum temperature, and if the experiment is stopped after 12 to 15 hours, just before the maximum temperature is reached, the leaves are stil quite fresh. Examination shows that bacteria or fungus-spores have little if anything to do with this first increase in temperature, which must therefore be entirely due to respiration of the leaves. When the maximum temperature is reached, the leaves die and bacteria and fungus-spores rapidly germinate, producing a second rise in temperature which may be even greater than the maximum temperature reached at first. Finally the temperature again falls until it reaches that of the room. The action of the germinating spores, etc., together with that of enzymes and chemical processes, are doubtless responsible for the second rise in temperature. The above results are not obtained with wet or submerged leaves.

Reversing Currents in Plasmodia of Mycetozoa.†—A. E. Hilton has studied the streaming movements in the plasmodia of *Badhamia utricularis*, and draws the following conclusions from his observations. The currents in the larger veins control the movements in the finer threads. The main currents in the large veins radiate from and converge to definite centres. Removal of these centres causes diminution and disorganisation of the streaming, but in a short time the denser portion of the remaining mass forms a fresh centre, and streaming is renewed. If two separate portions of a plasmodium coalesce, one or other of the two main centres acquires predominance and controls the streaming of the whole. When one large plasmodium has more than one centre of control, severance takes place at the limits of control of each centre unless harmony is established. A certain relative proportion must be maintained between the mass of the controlling centre and that

* Bot. Zeit., lxvi. (1908) pp. 211–33 (2 figs.).
† Journ. Quekett Micr. Club, ser. 2, x. (1908) pp. 263–70.

of the area controlled. The author believes that the streaming is due to pressure and suction produced by dilatations and contractions of a slow, rhythmic respiration.

Physiology of the Cells of Spirogyra.*—C. van Wisselingh has studied the physiology of *Spirogyra*, and finds that the influence of the nucleus starts before karyokinesis, when it determines the position where cross-wall formation shall take place. Starch-absorption is dependent upon certain chemical changes brought about under nuclear influence. Cell-walls are formed by the action of the nucleus in converting starch into materials suitable for wall-formation. The nucleus also exerts an indirect influence upon turgidity. The chromatophores appear to have a certain individuality apart from the nucleus, for small pieces can grow and form pyrenoids in cells which have no nuclei. Starch-formation in the chromatophores is not directly influenced by the nucleus. The plasma is able to increase in cells which have no nucleus. Movements of the plasma are not directly weakened by the absence of the nucleus, and the plasma of those cells which are without a nucleus streams much more quickly than in normal cells.

Irritability.

Influence of Light on Fruit-development.†—W. Lubimenko has studied the effect of light in promoting the development of fruit, and finds that it is only during the first stage of fruit-development that light is absolutely essential; subsequent to this period the fruits will develop equally well in darkness. The experiments show, however, that fruits ripening in darkness have fewer seeds than those growing in light; also that the dry weight of such fruits is less. A few experiments made upon *Prunus Cerasus*, *Vitis vinifera*, and *Sorbus Aucuparia* show that the acidity of the fruits developed in partial daylight is usually much less than that of fruits ripened in the open air. Thus light appears to be an important factor in fruit-development.

Effect of Light upon the Colour of Algæ.‡—G. A. Nadson gives the result of his experiments upon the effect of the intensity of light upon the colouring of algæ. The blue-green *Phormidium laminosum* grows in shady places. A specimen placed in a window facing east, so as to catch some sunshine daily, assumed in two months time a bright golden-yellow colour. In autumn, as the sunshine weakened, the blue-green colour partly returned. Similarly a yellowed specimen, after removal to a shaded position, regained in about four months its typical blue-green colour. *Oscillaria amphibia* behaves in the same way. Some of the Rhodophyceæ—*Porphyra laciniata*, *Nemalion lubricum*, *Laurencia obtusa*—in bright sunshine assume a brownish-yellow or golden-brown colour. In *Phormidium* the amount of chlorophyll diminishes in bright sunshine and the yellow colouring matter (lipochrome) becomes the more evident. The colour changes can be ranged in three categories:—(1) the fading and change to a pale yellow;

* Bot. Centralbl., xxiv. (1908) pp. 133–210 (3 pls.).
† Comptes Rendus, cxlvii. (1908) pp. 1326–8.
‡ Bull. Jard. Impér. Bot. St. Pétersbourg, viii. (1908) pp. 122–43 (pl.).

(2) the replacement of Floridean red by a green; (3) the appearance of the yellowish-brown pigment. The first is pathological; the second is chromatic adaptation; the third is a pigment protecting the alga against excess of light, and the author discusses the question as to whether it is in the cell, in the cell-membrane, or in the surrounding water.

Effect of Alkaloids in Regeneration.*—S. Morgulis has made experiments upon the scarlet runner bean in order to test the power of alkaloids in hastening regeneration of wounded or removed organs. The alkaloids used were a $\frac{1}{100}$ p.c., a $\frac{1}{1000}$ p.c. and a $\frac{1}{10000}$ p.c. solution of each of the following, viz. sulphates of atropine, strychnine, pilocarpine hydrochloride, and digitalin. The seedlings were placed in suitable jars containing the solutions, and the stems were then removed. With the exception of the stronger solutions of strychnine, the plants were uninjured by concentrations which would have proved fatal to animals. The effects produced varied with the strength and the nature of the solutions, but there was a general increase in the rate and intensification of the vital processes, especially that of transpiration. Also the rate of regeneration is increased in relation to this quickening of the various physiological processes.

Effect of Gas upon Carnations.†—W. Crocker and L. I. Knight have studied the effects of illuminating gas and of ethylene upon flowering carnations, and find that the latter are very sensitive to traces of the gas, young buds being killed by three days' exposure to 1 part in 40,000 parts of air. The injury is directly upon the flowers and is not due to root-absorption. Ethylene is even more injurious, since a three days' exposure to 1 part in 1,000.000 parts prevents the opening of buds, and a twelve-hours' exposure to 1 part in 2,000,000 parts causes open flowers to close. It is probable that the toxic effects produced by illuminating gas are due to the ethylene which it contains.

General.

Function of the Male Cell in the Determination of Sex.‡—C. Correns has made experiments with various plants of *Plantago lanceolata* in order to determine the function of the male cell in relation to the sex of the offspring. The author draws the following conclusions from the results of his experiments. The formation of the offspring as regards sexuality depends upon the character of the plant producing the egg-cell and also upon that producing the pollen. The more pronounced the female tendency of the germ-cells, so much the less is the effect produced by the origin of the male cells. The influence of the pollen, however, shows itself not only in the two extreme sexual forms but also in the intermediate forms. On the whole it would appear that the formation of the andrœcium and gynœcium of any particular stocks and the sexual composition of the offspring of these stocks are not always quite parallel.

* Ohio Nat., ix. (1908) pp. 404–12 (5 figs.).
† Bot. Gaz., xlvi. (1908) pp. 259–76 (4 figs.).
‡ Bot. Gesell., xxvi*a*. (1908) pp. 686–701.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A. F.L.S.)

Phylogeny of the Pteridophyta.*—I. Browne continues her account of the phylogeny and inter-relationships of the Pteridophyta, and treats of the Filicales under the following headings:—Botryopterideæ, Hymenophyllaceæ, Schizæaceæ, Gleicheniaceæ, Matonineæ, Cyatheaceæ and Polypodiaceæ, Loxomaceæ, Osmundaceæ, Salviniaceæ, Marsiliaceæ, Psaronieæ, Marattiaceæ, Ophioglossaceæ. She appends a bibliography.

Stipes of Clepsydropsis.†—P. Bertrand, during a study of the Zygopterideæ, has discovered the secondary rachis of *Clepsydropsis*, one of the most ancient of fossil ferns, and previously known only by the primary rachis of their fronds: and further, by making use of the peculiar structure of the leaf-traces of *Clepsydropsis* he has been able to discover the stipes of the plant. This stipes is represented by the fossils named by Unger:—*Syncardia pusilla*, *Hierogramma mysticum*, *Arctopodium insigne*, *A. radiatum*, *Cladoxylon mirabile*, *C. dubium*, *C. centrale*. *Schizoxylon tæniatum*. These seem to be referable to two species. The author describes the character of the vascular bundles and the secondary wood; and concludes with an allusion to the facts that these Cladoxyleæ have been referred by turns to the Lycopodiaceæ, the Ferns, and the Medulloseæ, as if all these types, traced to their original forms, converge towards one common form, to which *Clepsydropsis*, with its very primitive characters, would be infinitely nearer than any other plant actually described.

Foliar Gaps in the Lycopsida.‡—E. C. Jeffrey has studied the Lycopsida (= Lycopodiales, Psilotales, Equisetales and Sphenophyllales) in special reference to foliar gaps. The latter should occur immediately above but not lateral to the corresponding leaf-traces, and the author cannot therefore regard the perforations of the tubular central cylinder which are found in *Phylloglossum*, *Tmesipteris*, the *Lepidodendreæ* and the *Sigillarieæ* as true foliar gaps. Such gaps are also absent in the cone axis and vegetative stem of *Equisetum*, and in the reproductive and vegetative axes of *Calamites*. The Lycopsida are to be regarded as a great natural phylum distinguished by "a palingenetically microphyllous habit, the absence of foliar gaps in the tubular stele, and the possession of sporophylls with adaxial sporangia."

Young Stages of Dicksonia and Cyathea.§—G. B. Stephenson publishes an account of his studies of the young stages of *Dicksonia* and *Cyathea*. Cultures of the prothallia of *Dicksonia squarrosa*, *Cyathea dealbata*, *C. medullaris* and *C. Cunninghamii* were grown: and microtome sections were made from them and the young sporophytes, permitting a

* New Phytologist, vii. (1908) pp. 230–53; viii. (1909) pp. 13–31.
† Comptes Rendus, cxlvii. (1908) pp. 945–7.
‡ Bot. Gazette, xlvi. (1908) pp. 241–58 (2 pls.).
§ Trans. Proc. New Zealand Inst., xl. (1908) pp. 1–16 (5 pls. and figs.).

description with numerous figures of the development of the sexual generation, antheridia, archegonia, embryo, sporophyte, its petioles, stomata, vascular bundles, mucilage, protoxylem, stelar structure. The author comes to the conclusion that in the few tree-ferns examined the form of the stele is too directly adaptive to prove relationship. The function of the stem decides the form of the stele. In a creeping stem, not too bulky, a tubular stele is found, as in some species of *Pteris*, *Hypolepis*, *Polypodium punctatum*, etc. In a creeping stem extensively used for storage of starch and water an extreme polystely is found. In an upright stem with crowded leaves a tubular stele with leaf-gaps occurs, as in the tree-ferns and in large forms of *Polypodium pennigerum* and *Aspidium aculeatum*.

Submersed Fern.*—A. Ernst writes on the ecology and morphology of *Polypodium pteropus* Bl., a fern found growing submersed in a garden tank in one of the Sunda Islands. There is no question that it is *P. pteropus*, though differing somewhat from the normal land-form. Its rhizome is much more developed and ramified, and produces adventive rhizoids and organs of attachment; the leaves are smaller and simple; scales fewer; tissue less developed; spore production is normal. On the whole the differences are by no means so great as might have been expected in a form with so different a habitat.

Inconspicuousness of Ophioglossum vulgatum.†—G. Chauveaud publishes a note on the frequent occurrence of *Ophioglossum vulgatum* in the meadows of Charente, and shows how difficult the plant is to discover, even when known to occur in the immediate neighbourhood. He himself was unaware of the presence of the plant until, in making a gravel path, he destroyed the turf alongside. To his surprise this bare strip produced a large crop of *Ophioglossum* in the following spring. And a very careful search of the surrounding meadows showed that the plant was abundant, but remarkably inconspicuous. The fertile spike is usually devoured by snails and slugs.

Lycopodium alpinum in Dublin.‡—W. B. Bruce records the finding of *Lycopodium alpinum* on the summit of Cruagh, in Co. Dublin, at 1714 ft. above sea-level. Growing among short heather, it is difficult to distinguish. D. Orr's previous record for the county has been regarded as very doubtful.

North American Ferns.—W. N. Clute § publishes an article on fifteen years of fern study, the period covered by the Fern Bulletin, in which he calls attention to the paucity of fern literature in North America in 1892, and traces the gradual development of the study in succeeding years. E. T. Winslow ‖ offers an interpretation as to why, in *Polystichum acrostichoides* var. *incisum*, the much enlarged and pinnately incised lower pinnæ should be fertile at their tips. W. N. Clute ¶ writes on the ecology of some tropical ferns, basing his account

* Ann. Jard. Bot. Buitenzorg, xxii. (1908) pp. 103–43 (3 pls.).
† Bull. Soc. Bot. France, lv. (1908) pp. 627–8.
‡ Irish Naturalist, xvi. (1907) p. 368.
§ Fern Bulletin, xv. (1907) pp. 97–100.
‖ Tom. cit., p. 101 (fig.). ¶ Tom. cit., pp. 102–19.

upon E. B. Copeland's paper on the comparative ecology of San Ramon Polypodiaceæ in the Philippine Islands, suggesting the relation between morphology and environment in numerous details. The same author * publishes a portion of his check-list of the North American Fernworts, comprising species 167–211, *Polypodium* to *Woodwardia*. M. Slosson † publishes notes on some hybrid ferns. Speaking of *Dryopteris cristata* × *marginalis*, she speculates as to why, in the great majority of the hybrids, the root-stock should be upright, as in *D. marginalis*, rather than creeping, as in *D. cristata*. The half-evergreen leaves of the hybrid last longer into the winter than do those of *D. cristata*, but not so long as those of *D. marginalis*. The number of recorded American hybrids is rapidly increasing. For instance, in *Dryopteris* there are at least six species which intercross, whence fifteen hybrids are possible. Nine of these have been recorded; four more are about to be published; and the remaining two are confidently expected. W. N. Clute ‡ gives a figure and description of *Polypodium gramineum*, an epiphytic fern abundant in the elevated parts of Jamaica. G. T. Cleveland § gives an account of the ferns of the Upper Susquehanna valley, prefaced by some notes on the physical geography of the district. The rarer ferns only are enumerated, and these amount to thirteen species. J. C. Buchheister ‖ describes the natural habit of *Nephrodium simulatum* when growing wild, and points out how it differs from *N. eboracense* and *N. thelypteris*. He wonders whether it can possibly be a hybrid of these two species. A. N. Rood ¶ describes a habitat of *Lycopodium lucidulum* var. *porophilum* in Ohio. The plant itself was at first mistaken for *L. Selago*, a species which does not occur so far south. W. N. Clute ** describes and figures *Osmunda cinnamomea* f. *cornucopiafolia*, a new abnormal form found in Ohio, characterised by the rachis of the pinnæ being denuded above the middle, but bearing a small, apical group of pinnules; again, several of the lower pinnules bear a stalked ascidium terminating a veinlet which arises from the middle of the underside of the pinnule. He also writes an obituary notice of the late Alvah A. Eaton,†† a well-known American pteridologist, who died last September aged 43. S. H. Burnham ‡‡ gives an account of *Asplenium ebenoides* as grown under cultivation. It is a hybrid of *Asplenium platyneuron* and *Camptosorus rhizophyllus*, and occurs in limestone pockets in company with the two parent species. While resembling the first parent in general appearance, it retains the tapering rooting fronds of the second parent. It thus propagates itself by plantlets arising from its rooting apices. C. C. Plitt §§ publishes some notes on *Equisetum hyemale*, and shows (1) that the species has two periods of spore-shedding—one during the latter half of April from the bursting of the sporangia formed after the middle of July in the preceding year; and the other during the first half of July from the sporangia born on the newly

* Fern Bulletin, xv. (1907) p. 120–7.
† Op. cit., xvi. (1908) pp. 97–9.
‡ Tom. cit., pp. 99–101 (pl.).
§ Tom. cit., pp. 101–3.
‖ Tom. cit., pp. 104–5.
¶ Tom. cit., pp. 105–6.
** Tom. cit., pp. 107–9.
†† Tom. cit., pp. 109–11.
‡‡ Tom. cit., pp. 111–13.
§§ Tom. cit., pp. 113–16.

produced shoots. (2) When cut stalks of mature *Equisetum hyemale* are put into water, small papillæ (branches) appear on the lowest node in five days, and two days later appear on the node next above. These new branches grow up into the air, and from their base put out roots which grow down into the water. Similarly when cut stems are planted in the soil. Not more than three branches arise from a node, and not more than three nodes put out branches. R. C. Benedict* publishes some notes on ferns seen during the summer of 1908. A second station for the hybrid *Dryopteris Goldieana* × *marginalis* Dowell has been found near Jamesville, N.Y. Two new localities for *D. simulata*, Davenport, in New York State, are reported. *D. dilatata* Gray has been found on Blue Mountain, N.Y., at an altitude of 3000 ft. Two aberrant forms of *Osmunda cinnamomea* L. are described.

Indian Ferns.—R. H. Beddome† has been studying the late C. W. Hope's articles on the Ferns of North-west India published in previous numbers of the Journal of the Bombay Natural History Society, and offers criticisms upon some fifteen of the species created by Hope. Holding a much broader conception of the proper limits of a species, he considers that Hope did not make sufficient allowance for the variability of a species, and that he did wrong in wishing to make species out of the varieties of such well-known cosmopolitan ferns as *Polystichum aculeatum* and *Lastrea Filix-mas*—varieties which it is often almost impossible to distinguish owing to their being linked up by intermediate forms. Beddome suggests that if gardeners in India would carefully raise from the spores the different varieties of *Athyrium Filix-femina*, *A. nigripes*, *Polystichum aculeatum*, *Lastrea Filix-mas*, some very interesting scientific results would be forthcoming.

E. Blatter‡ publishes some contributions to the flora of North Coimbatore founded on materials supplied by C. E. C. Fischer, and including a list of 50 ferns.

E. Blatter§ gives an enumeration of 110 species and varieties of ferns recorded for the Bombay Presidency, with their full distribution (1) in the Presidency; (2) in India; (3) outside India. The sources from which the list was compiled are duly indicated, viz., literature, herbaria, etc.

The same author‖ enumerates 236 species and varieties of Ceylon ferns in the Bombay Natural History Society's Herbarium, with their distribution in Ceylon so far as is known. New records by Macpherson are included.

Ferns of Annam.¶—H. Christ publishes an enumeration of the ferns of French Annam collected by M. Eberhardt, who explored the ranges of Lang Bian (5500 ft.) and of Tam-Dao (3000 ft.), the ferns of South Annam being previously but little known. In character the fern-flora is mainly Indo-Malayan with a sprinkling of Chinese forms and some endemics. The list contains 123 species, of which about a score are new.

* Torreya, viii. (1908) pp. 284–6.
† Journ. Bombay Nat. Hist. Soc., xviii. (1908) pp. 338–42.
‡ Tom. cit., pp. 390–429.
§ Tom. cit., pp. 599–612.
‖ Tom. cit., pp. 639–48.
¶ Journ. de Bot., xxi. (1908) pp. 228–40, 261–74.

Ferns of South China.—E. B. Copeland * gives a list of 48 ferns from South China. They were collected in Kwangtung province by H. A. Kemp, in the mountainous interior of Kwangtung and Fokien provinces by C. G. Matthew, and in Fokien by S. T. Dunn. The species enumerated are those which present especial interest. Among them are eight new species. C. G. Matthew † publishes notes on the ferns of Hongkong and the adjacent mainland, including 147 species and eight varieties ; but he shows that nine of the older records are either erroneous or require confirmation. The list is the result of four years' study and collection. In the introduction the author describes the physical geography of the island and the adjacent mainland, and indicates the chief hunting grounds. The paper is privately printed.

Corean Ferns.—H. Christ‡ describes six species and three varieties of ferns, all new to science, and collected in Corea and the island of Quelpaert by the Abbé Faurie. The descriptions are included in Léveillé's Decades plantarum novarum, iv. and v. H. Christ § also describes four new species and one variety of ferns from Corea collected partly by Taquet, partly by Faurie.

Ferns of the Philippines.—H. Christ ‖ publishes a second selection of new or imperfectly known Philippine ferns. Twelve of them are described as new. E. B. Copeland ¶ gives a revision of the Philippine species of *Athyrium*. He insists upon the separation of *Athyrium* from *Asplenium*, and unites with the former the genera *Diplazium* and *Anisogonium*. There are 46 species, and these he arranges in 14 groups, adding a key for their more easy discrimination. Five of the species are described for the first time. He gives the reasons for doing away with the artificial divisions between the three genera, as first suggested by Milde. The same author** publishes some notes upon *Balantium* Kaulf. and *Brainea* Hook., two genera now ascertained to occur in the Philippine Islands. He discusses the affinity of *Balantium* to *Dennstædtia*.

Ferns of the Philippine Islands.††—E. B. Copeland gives an account of the Pteridophytes of the Horn of Negros, a mountain 6000 ft. high in the extreme south of the island of Negros in the Philippine group. The specimens represent 180 species, and were collected in March–June, 1908, by A. D. E. Elmer. Fourteen species and three varieties are new to science. The mountain has an extremely wet climate. Descriptions, notes, and criticisms are interspersed in the enumeration of the plants.

New Lycopodium from Tahiti.‡‡—W. Herter describes *Lycopodium Haeckelii*, a new species allied to *L. funiforme* Cham. of the West Indies. *L. Haeckelii* was collected in Tahiti by Ribourt in 1850, and is preserved in the herbarium of the Paris Museum.

* Philippine Journ. Sci. (Bot.) iii. (1908) pp. 277–84.
† Edinburgh : Douglas and Foulis, 1908 (35 pp.).
‡ Fedde, Repertorium, Berlin, v. (1908) pp. 10–12.
§ Tom. cit., pp. 284–5.
‖ Philippine Journ. Sci. (Bot.) iii. (1908) pp. 269–76.
¶ Tom. cit., pp. 285–300.
** Tom. cit., pp. 300–1.
†† Leaflets of Philippine Botany, ii. (1908) pp. 387–426.
‡‡ Fedde, Repertorium, Berlin, v. (1908) p. 22.

Ferns of New Guinea.*—E. Rosenstock publishes descriptions of a second series of eleven new ferns collected by E. Werner in New Guinea, adding a list of fifty-two determinations of species already known to science, and a few notes supplementing his previous paper in the same periodical.

Notes on Ferns of New Zealand.—H. C. Field † gives an account of two new ferns found in New Zealand. One—*Doodia aucklandica*—was growing in some scrub near Takapuna Lake, Auckland, and resembled *Lomaria filiformis*, but after being cultivated for a year it produced fertile fronds and showed itself to be a *Doodia*, but different in habit from *D. media* and *D. caudata*. The other novelty—*Pteris novæ-zelandiæ*—came from Waikanae, and at first seemed to be a *Botrychium*. It approaches *Pteris tremula*, but differs in several respects from that species. The author adds some remarks upon the cresting of ferns and the causes of it.

L. Cockayne ‡ publishes some hitherto unrecorded habitats for nine New Zealand ferns.

T. F. Cheeseman § in an addendum to some notes on botanical nomenclature shows how the new Vienna rules affect ten of the New Zealand ferns.

Abnormal Ferns in New Zealand.—A. Hamilton ‖ gives an account of a number of abnormal developments in New Zealand ferns which had previously escaped notice. He describes and figures the variations, abnormalities, and crestings more or less remarkable, which he has noticed in *Lomaria fluviatilis*, *L. procera*, *Dicksonia squarrosa*, *Adiantum Cunninghamii*, *Cheilanthes tenuifolia* or *C. Sieberi*, *Asplenium umbrosum*, *A. trichomanes*, *A. flabellifolium*, *Aspidium aculeatum*, *Polypodium Billardierii*, *P. tenellum*, *Leptopteris hymenophylloides*. He also gives a list of the papers which have been published on the ferns of New Zealand. H. C. Field ¶ gives some notes on a few peculiar New Zealand ferns. *Lomaria vulcanica* is usually a tufted fern with a crown of fronds sometimes raised 2 or 3 inches above the ground on a short caudex; but near Rotorua and Tauranga it occurs as a creeping variety with wide spreading rhizomes, producing fronds at intervals of several inches. This variety the author names *repens*. Another fern, collected in the Piako swamp, presents very peculiar features. It is *Nephrodium unitum* which is very old and has elongated its crown into a sort of (forked) caudex 18 inches long in its endeavour to escape from being smothered by the rise of the surface of the swamp; and the fronds emerging from the sides of the caudex have grown up to the surface of the swamp as long rachises bearing very small fronds. Another fern from the bank of the same Piako swamp has somewhat the form of an *Adiantum*, but on close inspection clearly is an abnormal form of *Aspidium Richardi*, one of the commonest New Zealand ferns.

* Fedde, Repertorium, Berlin, v. (1908) 370–6.
† Trans. Proc. New Zealand Inst., xxxviii. (1906) pp. 495–8.
‡ Op. cit., xl. (1908) pp. 305. § Tom. cit., pp. 464–5.
‖ Op. cit., xxxvi. (1904) pp. 334–42 (2 pls.).
¶ Op. cit., xxxvii. (1906) pp. 377–8.

Ferns of West Africa.—C. Christensen* gives a new description of *Leptochilus* (*Bolbitis*) *acrostichoides*, a fern from French tropical West Africa, originally named by Afzelius, and recently collected by A. Chevalier.

H. Christ † describes four new ferns from French tropical West Africa, collected by A. Chevalier, and adds some critical notes on a few other species.

Bolivian Ferns.‡—E. Rosenstock publishes descriptions of sixteen new ferns and one fern-ally, collected in 1906–7 in the Bolivian province of Yungas by O. Buchtien. H. Christ is part author for some of the species.

New Ferns.§—E. Rosenstock publishes descriptions of the following new ferns: *Notochlæna Herzogii* and *Polypodium Herzogii* from Bolivia; *Asplenium Lademannianum* and *A. prægracile* from German East Africa; and *Alsophila aquilina* var. *Maxoni*, from Cuba.

New Fossil Species of Salvinia.‖—P. H. Fritel gives a diagnosis of a new fossil *Salvinia*—*S. Zeilleri*—found by him in clay at Cassoy (Seine-et-Marne), and belonging to the early Tertiary period. He makes an analysis of the living species of the genus, and of the fossil representatives which have been recorded, and compares the two sets. The most ancient forms of the genus (*S. elliptica*, of America, and *S. Zeilleri* of Europe) are comparable to living forms which occur in the tropics; those which are found in the Oligocene and Miocene belong to the type of the living *S. natans*. The conditions of climate prevailing in the Paris basin at the epoch when *S. Zeilleri* flourished, must be almost identical with those which now prevail in the regions where *S. auriculata* (so nearly allied to *S. Zeilleri*), is found in tropical America. The extremely close relationship between the most ancient forms and certain existing species, indicates that the evolution of the genus *Salvinia*, since its earliest known appearance, has been almost nil.

Fossil Prothallus.¶—W. T. Gordon describes and figures the prothallus of the fossil *Lepidodendron Veltheimianum*, that is to say, the prothallus preserved within the wall of the megaspore; and just within the three-lobed opening at the apex of the spore is the small-celled archegonial tissue, but no archegonia could be detected.

Obituary Notice of Alvah A. Eaton.—R. G. Leavitt ** writes an obituary notice of the late Alvah Augustus Eaton, who was born in 1865 and died in September, 1908, and had devoted much of his life to the collection of plants, and to the study of North American ferns and fern-allies. M. A. Day †† supplies a list of the botanical writings of the late A. A. Eaton. These are fifty-two in number, and date from 1896 to 1908.

* Bull. Soc. Bot. France, liv. Mém. 8a (1907) pp. 29–30 (fig.).
† Op. cit., lv. Mém. 8b (1908) p. 105–9.
‡ Fedde, Repertorium, Berlin, v. (1908) pp. 228–39.
§ Op. cit., vi. (1908) pp. 175–9.
‖ Journ. de Bot., xxi (1908) pp. 190–8 (figs.).
¶ Trans. Proc. Bot. Soc. Edinburgh, xxiii (1908) pp. 330–32 (pl.).
** Rhodora, x. (1908) pp. 209–11. †† Tom. cit., pp. 211–14.

Bryophyta.

(By A. Gepp.)

Androgynous Inflorescences in Dumortiera.*—A. Ernst publishes his researches into the development, structure and distribution of the inflorescences of *Dumortiera*, the material studied having been Javan specimens of the monœcious *D. trichocephala* and the diœcious *D. velutina*. *D. trichocephala* has androgynous as well as purely male and purely female inflorescences. Ernst describes the two species systematically and gives their distribution in Java. He then devotes a chapter to each of the following subjects:—The structure of the thallus of the two species; the structure and development of the male and female inflorescences; the androgynous inflorescences; observations on the distribution of male and female receptacles and the occurrence of androgynous inflorescences in *D. velutina* and *D. trichocephala* respectively, gathered in various localities, showing by statistics the rarity of androgyny in *D. velutina*; the phylogeny of *Dumortiera*.

Origin of Cupule of Marchantia.†—C. R. Barnes and W. J. G. Land describe and figure the development of the cupule of *Marchantia* from its earliest stage, their purpose being to discover whether the cupule could possibly be homologous with the air chamber. They show that the first hint of the site of the gemmiparous area may be found so near to the apical cell as in the third segment. The rudimentary gemmiparous cell remains simple and undergoes no periclinal divisions such as are evident in the other superficial cells around it, which by subsequent divisions produce the air-chamber tissue. The development of the rim of the cupule, the increase of the gemmiparous cells by anticlinal divisions, the formation of the gemmæ, are severally described; and it is made quite clear that the gemmæ are in nowise homologous with the chlorophyllose filaments of an air chamber, nor has the cupule any relation to the epidermal roof of an air chamber. In fact air chambers are found in the thicker part of the wall of the cupule. The rudiment of a cupule is clearly shown in the figures to be equivalent to the cells which might produce roof, filaments and floor of an air chamber together with some of the thallus beneath it. The authors reject Goebel's conception that in *Marchantia* the gemmæ are homologous with slime papillæ.

Farrants' Medium for Mosses.‡—W. B. Davis strongly recommends the employment of Farrants' medium of mounting mosses, because of its easy application and satisfactory endurance. He gives some hints for its use, and cites a recipe of the following composition:—equal parts of gum arabic, glycerin and water with a trace of arsenious oxide as preservative.

Importance of Pedicel in Classification of Hepatics.§—C. Douin has investigated the structure of the pedicel of the sporogonium of

* Ann. Jard. Bot. Buitenzorg, xxii. (1908) pp. 153–223 (7 pls.).
† Bot. Gaz., xlvi. (1908) pp. 401–9 (14 figs.).
‡ Bryologist, xii. (1908) p. 8.
§ Bull. Soc. Bot. France, 1908, pp. 194–202, 270–6, 360–6, 368–76 (4 pls.). See also Rev. Bryolog., xxxv. (1908) pp. 142–3.

Hepaticæ with a view to its importance as an aid to classification. He finds the following general rules: 1. When a genus is a natural one the characters of the pedicel are identical in all its species. 2. The characters derived from the pedicel are generic at least, never specific. 3. Of all the parts of the sporogonium the pedicel is the least subject to variation and consequently is very constant. It has an exceptional importance in classification.

Classification of Mosses.*—V. F. Brotherus continues his account of the mosses in Engler and Prantl's Die Natürlichen Pflanzenfamilien. After finishing off the remaining tribes of Hypnaceæ, namely, the Hylocomieæ (among which the genus *Hypnum* is found restricted to one species, *H. Schreberi*), he treats of the Stereodonteæ (with seven genera) and the Plagiothecieæ (seven genera). In Leucomiaceæ are two genera, in Sematophyllaceæ are twelve, in Rhegmatodontaceæ are two, in Brachytheciaceæ are twenty (thirteen of which are treated in the present part).

Report of the Moss Exchange Club.†—The Moss Exchange Club in their thirteenth annual report give several pages of records of mosses and hepatics found in Britain. To some of the species descriptive or critical notes are appended. Five of the species had never previously been discovered in this country; hence English descriptions of them are included in the report.

Yorkshire Muscineæ.—W. Ingham‡ reports upon the more interesting hepatics collected during an excursion of the Yorkshire Naturalists' Union to Topcliffe, Yorks. Mention is made of the rare hepatic, *Cephalozia fluitans*, of some rare forms of *Sphagnum*, of *Plagiothecium latebricola*, and other mosses.

He also reports§ upon the bryological results obtained during the August excursion to the Western fringe of the Cleveland Hills, in the vicinity of Osmotherley, where the most interesting finds were some forms of *Sphagnum*.

Scottish Muscineæ.‖—W. Evans gives a list of the mosses and hepatics obtained at various times from the Island of May, at the Mouth of the Firth of Forth, namely, eighteen mosses and seven hepatics. The two most interesting species are *Bryum alpinum* and *Frullania germana*, the one being rarely found at a low level in the east of Scotland, and the other being what is called an "Atlantic," or West Coast species. *Fissidens viridulus* and *Grimmia Stirtoni* are also worthy of note.

J. Stirton,¶ continuing his researches into the minute structure of mosses in the barren state, describes as new, six species gathered in various parts of Scotland:—*Grimmia fuliginosa*, from Arisaig; *G. inæqualis*, from near Glasgow and Forth Bridge; *Mnium gracilentum*, from near

* Leipzig: Engelmann, 1908, lief. 232, 233, pp. 1057–1152 (figs. 758–813).

† York: Coultas and Volans, 1908, pp. 267–94.

‡ Naturalist, No. 618 (1908) pp. 281–2.

§ Op. cit., No 622 (1908) pp. 407–9.

‖ Trans. Proc. Bot. Soc. Edinburgh, xxiii. (1908) pp. 348–51.

¶ Ann. Scott. Nat. Hist., No. 67 (1908) pp. 171–6.

the summit of Ben Lawers; *Philonotis heterophylla*, from near the summit of Ben Lawers; *A. geophilum*, from the West Coast; *Amblystegium perminimum*, often closely associated with the preceding species. He also reports *A. compactum* (Sulliv.), as occurring at Loch Killisport and Cardross on the Clyde, and *Cynodontium gracilescens* (Web. and Mohr), as near Balmaha, Loch Lomond.

S. M. Macvicar * publishes some additions for 1907 to the Census of Scottish Hepaticæ. The list contains ninety-seven new records, arranged under counties or vice-counties. *Scapania obliqua* Schiffn. and *Lophozia Baueriana* Schiffn. are additions to the flora.

Irish Muscineæ.†—D. McArdle has prepared the lists of Muscineæ for the Dublin Handbook of the British Association. (1) He says that the number of mosses recorded for County Wicklow is 219 species, and for County Dublin is 250 species. Fifteen of the Irish mosses are found in these two counties only. He enumerates sixty-three of the rarer species found in Dublin and Wicklow, adding a list of ten species which have not been found recently, and perhaps are extinct. Another list shows the remarkable geographical distribution possessed by twenty species. (2) The hepatics are treated on similar lines. In Dublin eighty-five species are found, in Wicklow ninety-nine species. Five Irish hepaticæ are found only in Dublin or Wicklow. Seven are found in Cork or Kerry also. The number of rarer species enumerated for Dublin or Wicklow is forty-one. Nineteen species are remarkable for their wide geographical distribution. Ten Dublin species and four Wicklow, not recently found, are perhaps now extinct. A bibliography is appended.

J. H. Davies ‡ publishes some notes upon mosses collected in Co. Down. In a list of twenty-one species he marks twelve as unrecorded previously for the county, three of them—*Tortula angustata*, *Barbula gracilis* var. *viridis*, and *Hypnum imponens*—being new to the Irish flora, and rare in the British Islands. *Archidium alternifolium* has escaped notice for seventy years. *Thuidium recognitum* is also apt to be overlooked. In a later note the *Archidium* is withdrawn.

The same author § reports a second station for the occurrence of *Weisia rostellata*, in Co. Antrim.

D. McArdle ‖ gives a list of eighty-seven mosses and forty-three hepatics collected by him during a few days' search in and near Correl Glen, in Co. Fermanagh, during October, 1905. Notes are added to the more interesting species.

J. Britten, H. W. Lett, and D. McArdle ¶ severally discuss the records of *Dicranum scottianum* in Irish literature, and clear away sundry errors pertaining thereto.

C. H. Waddell ** publishes a note on the rare occurrence of *Eurhynchium striatulum* in Ireland, giving some particulars as to its habitat and appearance. It grows chiefly in cool, shady spots on the

* Ann. Scott. Nat. Hist., No. 67 (1908) pp. 176–9.
† Handbook to the Dublin District, Brit. Assoc. Dublin, 1908, pp. 86–96 (1 pl.).
‡ Irish Naturalist, xvi. (1907) pp. 215–17; xviii. (1909) p. 23.
§ Tom. cit., p. 222. ‖ Tom. cit., pp. 232–8.
¶ Op. cit., xvi. (1907) p. 310; xvii. (1908) pp. 161, 187.
** Op. cit., xvii. (1908) p. 204.

north or east sides of dry stone walls. It has been gathered in Kerry, Wicklow, and Limerick. It is a southern species extending to the Mediterranean.

H. W. Lett * records the discovery of *Ditrichum tortile* at two stations in the north of Ireland, in which country it had not previously been noted.

Discovery of Pohlia bulbifera in France.†—G. Dismier found on the edge of a pond near Servance (Haute-Saône) the very rare moss *Bruchia vogesiaca*. Mixed with it were *Sporledera palustris*, *Atrichum tenellum*, *Fossombronia Dumortieri*, and fragments of a *Pohlia* bearing bulbils and having the stems slender, leaves distant and much spread owing to the size of the bulbils. Upon close investigation it turned out to be *Pohlia bulbifera*, a north German species not previously known to occur in France. It is distinguished from its allies *P. proligera*, *P. annotina*, *P. Rothii* by the special form of its bulbils, borne two or three together in the axils of the leaves of sterile stems, spherical or ellipsoidal, and crowned by three to five little leaves which are obtuse at apex, incurved, cucullate and connivent.

Schistidium tarentasiense.‡—R. Sebille describes and figures *Schistidium tarentasiense*, a new species of moss found in the Col de la Vanoise, near Pralognan, in Savoy, at an altitude of 8300 ft. It is distinguished from all other species of *Schistidium* by its habit, its little red capsules nearly half-way exserted above the short blunt perichætial leaves, which are entirely destitute of any hyaline apex.

Sphagnum molle in France.—G. Dismier § publishes a note upon his discovery of *Sphagnum molle* Sull. in the Basque Pyrenees on the northern side of the Franco-Spanish frontier. More than eight years ago he found the same species at Rochesson in the Vosges. He points out its diagnostic characters in the field and under the Microscope. The plant occurs in Finistère and Sarthe, and finds its southern limit in the Pyrenees.

F. Camus adds a note upon the importance of the above discovery, partly because of the incomplete knowledge of the distribution of the genus *Sphagnum* in the south-west of France, and partly because of the rarity of *S. molle* in France. It is the only European species which does not occur in Russia. It is widespread in the German plain, common in Belgium, rare in Britain and France.

Sphagnum pseudocontortum.‖—J. Röll shows that some plants from the Fichtelgebirge and Vogtland named *Sphagnum bavaricum* by Warnstorf are synonymous, not with *S. subcontortum* Röll (as Warnstorf alleged), but with *S. pseudoturgidum* Röll—an older name than *S. bavaricum* (a species recently recorded for the British Islands). The name *S. subcontortum* Röll having been forestalled is now changed to *S. pseudocontortum* Röll. The author adds a descriptive note to it.

* Irish Naturalist, xvii. (1908) pp. 204–5.
† Bull. Soc. Bot. France, lv. (1908) pp. 59–60.
‡ Rev. Bryolog., xxxvi. (1909) pp. 14–16 (figs.).
§ Bull. Soc. Bot. France, lv. (1908) pp. 603–5.
‖ Allgem. Bot. Zeitschr., xiv. (1908) pp. 198–9.

Moss-flora of Hamburg.*—R. Timm publishes a contribution to the bryology of the Hamburg district, consisting chiefly of the more important finds made by Wahnschaff and himself since 1900. He gives a brief résumé of the work done by previous authors. The total moss-flora is about 450 species. A curious unexplained problem is the occurrence of the saprophytic moss, *Tetraplodon mnioides*, a mountain-dweller, down in the plains near Geestemünde, Hamburg, and Magdeburg. The suggestion that the spores have been carried by blow-flies from the Brocken in the Harz Mountains does not meet the difficulties of the case. The occurrence of many so-called mountain species on boulders in river gorges leads to the reflection that such boulders are much commoner in the mountains than in the plains, that such species are boulder-dwellers, and that altitude has nothing to do with the matter. The author enumerates 208 mosses and 32 hepatics, interspersing them here and there with notes and figures.

Mosses in the Peat on the Baltic Coast.†—C. A. Weber, in a further note on the mosses in the peat on the Baltic coast between Sarkau and Cranz, states that he has examined the original material referred to *Hypnum turgescens* by C. Müller (Halle) in 1867, and finds it to be *Scorpiurium scorpioides*. He points out its distinguishing characters. He also states that the fragments referred to *Hypnum niteas* by C. Müller are *H. exannulatum*, and shows how the mistake probably arose through insufficient care in removing the leaves from the stems.

Mosses of the Eastern Alps.‡—W. E. Nicholson gives an account of a bryological excursion made by him with H. N. Dixon in August 1904 to South Tyrol and Carinthia, with a brief visit to Lago di Garda and Verona. Nine days were spent at Sulden and six at Heiligenblut. An enumeration of 120 mosses with localities and occasional notes is added.

Some Hungarian Mosses.—I. Györffy § gives an account of the moss *Coscinodon cribrosus* (Hedw.) Spruce and shows that it is a xerophilous species, as is proved by the character of its leaf-structure. He indicates some new stations in Siebenbürgen (Transylvania). The same author ‖ describes with much detail the mosses (1) *Bruchia palustris* var. *Degenii*, which represents the addition of a genus to the Hungarian flora; and (2) *Meesea trichodes* var. *alpina* and var. *minor*. The structure of the plants is beautifully illustrated. The text is in both Hungarian and German.

Russian Bryology.—A. A. Elenkin ¶ publishes a preliminary account of the lichen and moss formations in middle Russia. A. A. Sapehin ** gives an account of the distribution of the moss formations and of the species in the western part of the Taurus mountains in the Crimea.

* Abh. Natur. Verein Hamburg, xix. heft 2 (1907) 48 pp. (63 figs.).
† Engler's Bot. Jahrb., xlii. (1908) pp. 239–40.
‡ Rev. Bryolog., xxxvi. (1909) pp. 1–8.
§ Magyar Bot. Lapok, vii. (1908) pp. 133–40.
‖ Tom. cit., pp. 140–97 (4 pls.).
¶ Bull. Jard. Impér. Bot. St. Pétersbourg, viii. (1908) pp. 13–16.
** Tom. cit., pp. 53–86.

Bryophytes of Persia and Lydia.*—V. Schiffner publishes some contributions to a knowledge of the Bryophytes of Persia and Lydia—regions which are of interest in the consideration of the relationship of the moss-flora of the Mediterranean with that of middle Asia, and that of the Alps with the moss-flora of the Himalayas. The present list is based upon the collections made by J. Bornmüller during his various journeys in 1902 and 1906, by T. Strauss in Persia, and by J. A. Knapp in N.W. Persia in 1884. The enumeration contains 104 species, 66 of which are new records for Persia and Lydia; and 7 species and 4 varieties are described for the first time and are figured. There are 17 hepatics included in the above total of 104. Critical notes are appended to the interesting species.

Muscineæ of Spitsbergen.†—J. Hagen gives an account of the mosses and hepatics collected by W. S. Bruce when exploring Prince Charles Foreland, the most westerly island of the Spitsbergen Archipelago. Nineteen species of mosses and four of hepatics are enumerated. *Dicranum spadiceum* is a new record for Spitsbergen; and *Hypnum uncinatum* var. *fœneum*, is new to science. The habit of some of the species is noteworthy: for instance, the stunted dense tufts of *Dicranum elongatum* and *Jungermannia minuta*; again, the absence of sexual organs; for in the present collection only *Oncophorus Wahlenbergii* is found with fruit, and only one hepatic, *Jungermannia minuta*, has developed perianths. Another effect of the severe climate is that the tufts are rarely pure, but generally contain an intimate mixture of a number of species.

North American Bryophytes.—T. C. Frye ‡ publishes a list of six hepatics, seven mosses, and some lichens collected at altitudes between 2000 and 9000 feet on Mount Hood, in Oregon.

L. H. Handy § announces the discovery of *Fissidens Closteri* Aust. in Rhode Island. It has only once previously been found.

J. M. Holzinger ‖ echoes the urgent complaints of E. Levier, of Florence, against the baffling practice of North American bryologists in abbreviating the geographical data on their plant labels so much as to render them unintelligible to Europeans—thus L. I. for Long Island.

A. Lorenz ¶ reports the finding of *Georgia geniculata* at Waterville, in New Hampshire. It is a northern species, and has only once previously been found in New England.

Mosses of Panama.**—R. S. Williams gives a preliminary account of a recent collection of mosses made in Panama during March and April 1908. Thirty species were obtained, despite the unfavourable season. Twenty-five of these were of South American type, including *Pilotrichum amazonum* Mitt., and *Lepidopilum brevipes* Mitt., not found since Spruce first obtained them in the Andes. The other five species are Central American, and among them are two new species.

* Oesterr. Bot. Zeitschr. lviii. (1908) pp. 225–31, 304–18, 341–51 (3 pls and fig.).
† Trans. Proc. Bot. Soc. Edinburgh, xxiii. (1908) pp. 326–30.
‡ Bryologist, xii (1903) pp. 6–7.
§ Tom. cit., p. 9.
‖ Tom. cit., pp. 9–10.
¶ Tom. cit., p. 10.
** Torreya, viii. (1908) pp. 294–5.

South American Species of Riccia.*—V. Schiffner treats of some South American species of *Riccia*. 1. *Riccia ochrospora* Mont. et Nees, collected in Chile by Bertero; the original specimen in Herb. Lindenberg, being re-examined, proved to have a ripe sporogonium; and thus enabled a description of the spores to be given. 2. *R. synspora* Schiffn. is a new species collected by Reineck and Czermak in Brazil, and formerly referred to *R. membranacea* Lindenb. and Gott. by Schiffner, but now carefully distinguished from that species and furnished with a description. 3. *R. echinatispora* Schiffn. is a new species, the description of which will appear in the forthcoming report on the Brazilian Expedition; but in the meantime some notes on the development and structure of the sporogonium and spore are given.

Muscineæ of French Guinea.†—E. G. Paris publishes a bryological flora of French Guinea, comprising 183 mosses and 33 hepatics. Six years ago not a moss nor an hepatic was known from that district, but thanks to the exertions of H. Pobeguin and two other French officers, the present total has been reached. Of the mosses, 72 p.c. are endemic; of the hepatics, 13 p.c. Five new species of mosses are described; and descriptions of most of the others published in recent volumes of the Revue Bryologique are reprinted in the present paper.

Congo Mosses.‡—J. Cardot publishes a second article on the mosses of the Belgian Congo and the Casamance, in which he gives preliminary diagnoses of ten new species collected by Hens, Vanderyst, and Laurent on the Congo, and by Mathieu on the Casamance. He describes three new genera: *Fissidentella* (Fissidentaceæ), *Nanomitriopsis* (Funariaceæ), *Bryomnium* (Bryaceæ).

Moss-flora of Java.§—M. Fleischer publishes the third portion of his monograph on the Musci der Flora von Buitenzorg, and treats of the remaining seventeen families of the Isobryinæ, and of the four families of the Hookerinæ. He describes all the genera and species known to occur in Java, adding numerous notes on families, genera, and species which are found outside the limits of the island. Having submitted the group of mosses to a rigorous examination, he has come to some conclusions which are at variance with those expressed by Brotherus in Engler's Pflanzenfamilien, and has been compelled to institute some new genera and rearrangements.

Hepaticæ of the Philippine Islands.‖—F. Stephani describes three new liverworts—*Anthoceros Elmeri*, *Plagiochila Elmeri*, *Trichocolea Elmeri*—collected by A. D. Elmer, in Luzon, one of the Philippine Islands.

Two New Genera from Japan.¶—S. Okamura publishes an illustrated account of two new Japanese genera of mosses, recently described by

* Oesterr. Bot. Zeitschr., lviii. (1908) pp. 462–6.
† Bull. Soc. Bot. France, lv. Mém. 14 (1908) p. 1–66.
‡ Rev. Bryolog., xxxvi. (1909) pp. 16–20.
§ Leiden: Brill, iii. (1906–8) pp. xxiv. and 645–1103 (figs. 122–184.).
‖ Leaflets of Philippine Botany, ii. (1908) pp. 385–6.
¶ Tokyo Bot. Mag., xxii. (1908) pp. 29–31, 41–44 (2 pls.).

Brotherus, namely, *Orthomniopsis* and *Okamuræa*. Having obtained more complete material, Okamura is able to describe them in fuller detail.

New Mosses of Japan, China, and New Caledonia.*—J. Cardot and I. Thériot publish descriptions of thirteen new species of mosses collected in the Liou-kiou Archipelago by J. B. Ferrié in 1898–9.

I. Thériot † publishes diagnoses of six new species and varieties of mosses collected in Japan by J. B. Ferrié; four collected in the Chinese province of Kouy-Tcheou by J. Cavalerie and J. Esquirol; and ten collected by M. Franc in New Caledonia.

Chinese Mosses.‡—E. G. Paris publishes a ninth article on Mosses of Eastern Asia, giving a list of twenty-three species, collected by the missionaries Courtois and Henry, in the Chinese provinces of Kiang-Sou and N'gan-Hoei. Among them are descriptions of ten new species.

Fissidens algarvicus.§—G. Dismier discusses the species *Fissidens algarvicus*, described by Solms-Laubach in 1868 from material collected by him in the province of Algarve, Portugal. It was originally described as dioicous; but Dismier shows that the French specimens subsequently collected near Cherbourg, near Brest, and by Dismier at Banca (Pyrenees), and several other localities, are monoicous or pseudomonoicous. The late Abbé Boulay, in his Mousses de France, considered that *F. algarvicus* is a variety of *F. pusillus*. Dismier shows that *F. algarvicus* is a distinct species, characterised by a special habit, by narrow leaves longly and finely acuminate, or sometimes even apiculate, with a wide margin reaching the apex, by the proportion and shapes of the different laminæ of the leaf, and by the symmetrical leptodermous capsule.

Formation of Leucobryum Cushions.‖—W. H. Burrell gives his opinion as to the factors which control the formation of the unattached cushions in which the moss *Leucobryum glaucum* often occurs under beech trees. The factors are three :—1. Special cell-structure, enabling the plant to store water. 2. Formation of vegetative buds from rhizoids on the leaves. 3. Repeated accidental disturbance. The spongy leaf-tissue retains moisture for a long time, and relieves the plant from the necessity of maintaining a connection with the ground by means of rhizoids. Buds arise from the reddish-brown tomentum which is formed on the surface of the leaves, and develop into new plants: and as they develop upon whichever surface of the cushion happens to be uppermost, they at length produce a radiating structure in the cushion, if it be disturbed from time to time. The agents which roll the cushions over are, in the opinion of the author, pheasants and other animals in active search for beech-nuts.

Bucegia romanica.¶—V. Schiffner writes of the occurrence of the liverwort *Bucegia romanica* (first described from Roumania by Radian

* Bull. Acad. Internat. Geog. Bot. xviii. (1908) pp. ii–iii.
† Tom. cit., pp. 250–4. ‡ Rev. Bryolog., xxxvi. (1909) pp. 8–13.
§ Rev. Bryolog., xxxv. (1908) pp. 137–9.
‖ Trans. Norfolk and Norwich Nat. Soc., viii. (1908) pp. 537–9.
¶ Magyar Bot. Lapok, vii. (1908) pp. 36–9.

in 1903) in Hungary, ascertained by a revision of the material preserved under the name of *Preissia* in his own herbarium and in the Hof-museum at Vienna. The plant has thus been shown to occur on the Hohe Tatra. But, as it possibly grows all along the Carpathian chain, he begs for Hungarian specimens referred to *Preissia* for examination. And he states what are the macroscopic and microscopic characters by which *Bucegia* may be distinguished from *Preissia*.

Bryological Notes.*—V. Schiffner continues his bryological notes, and treats of the following subjects: 49. *Scapania obscura* (Arnell and Jensen) Schiffn., a new member of the flora of middle Europe. 50. Upon the occurrence of *Diplophyllum gymnostomophilum* in middle Europe. 51. Two new stations for *Neesiella carnica*. 52. Upon some interesting Hepaticæ of the French flora.

Mosses in the Peat of the Baltic Coast.†—C. A. Weber has studied afresh the plants in the peat layer in the coastal escarpment of the Kurland lowlands between Sarkau and Cranz. The mosses in this peat were stated, with some doubt, by C. Müller in 1868 to be chiefly *Hypnum turgescens* and *Camptothecium nitens*. One layer, immediately above the rubble-marl, is now found to consist, for the most part, of *Scorpidium scorpioides*; and with it are *Hypnum trifarium*, *H. giganteum*, *H. vernicosum*, *H. exannulatum*, *H. aduncum*, and some phanerogams. Another peat layer about 14 inches higher up consists mainly of *Hypnum vernicosum*, with which are associated *Scorpidium scorpioides*, *Hypnum trifarium*, *H. giganteum*, *Meesea tristicha* var. *timmioides*, and some phanerogams. By means of lists in parallel columns this flora is shown to be very similar to that of the peat of the Rostocker Heide on the Mecklenburg coast published in 1904. The author cannot believe that the expert C. Müller was mistaken in his determination of *Hypnum turgescens*. He therefore supposes that the layer from which C. Müller's sample came has since been destroyed by the sea.

Frère Gasilien: an Obituary Note.‡—An anonymous notice of the late Frère Gasilien, also known as G. Parrique, sketches his services to botany, and states what an active collector of mosses and lichens he was, searching for specimens at several spots in the central plain of France, and providing numerous records which have been published in Hériband's Muscinées d'Auvergne, and in the works of Cardot, Venturi, Stephani, Nylander, Hue, and others. Gasilien had a special knowledge of the genus *Cladonia*, and a few months before his death issued a published set of 200 specimens of *Parmelia*.

* Oesterr. Bot. Zeitschr, lviii. (1908) pp. 377–82.
† Engler's Bot. Jahrb., xlii. (1908) pp. 38–48 (fig.).
‡ Bull. Soc. Bot. France, liv. (1907) p. 752.

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

Ulva latissima in relation to Sewage-pollution of Sea-water.* E. A. Letts and W. E. Adeney, in their report upon the pollution of estuaries and tidal waters, treat of the nuisances caused by the growth in large quantities and subsequent decay of certain green seaweeds, chiefly *Ulva latissima*, with *Enteromorpha compressa* and *E. intestinalis* in less quantity. For example, in Belfast Lough, Dublin Harbour, and Southampton Water, the *Ulva* driven ashore by strong winds forms banks which, rapidly putrefying in warm weather, emit an overpowering stench of sulphuretted hydrogen, often mistaken for a nuisance caused directly by sewage. By appropriate experiments the authors determined that when the *Ulva* ferments it is attacked by a form of bacillus which probably acts upon the albuminoids of the alga, and certainly leads to the production of propionic and other fatty acids, with carbonic anhydride and hydrogen. Subsequently the *Ulva* is attacked by another form of bacterium which leads to the production of ferrous sulphide and sulphuretted hydrogen, such sulphur compounds being derived from the sulphates of the sea-water or of the alga (and not from its albuminoids). Further, the evidence shows that the occurrence of *Ulva* in quantity in a given locality is associated with the pollution of the sea-water by sewage.

A remarkable point is the high proportion of nitrogen in the chemical composition of the *Ulva*, and also the avidity with which the alga absorbs inorganic compounds of nitrogen, such as ammonia and nitrates from sea-water. These properties suggest the employment of *Ulva latissima* as a valuable source of ammonia. Enormous quantities of the plant are washed ashore in Belfast, and, though the farmers cart it away and put it on the land, they thus use but a very small fraction of it. *Ulva* and *Enteromorpha* play a great part in nature as scavengers and purifiers of polluted estuaries; on the one hand they rapidly absorb ammonia, nitrates and carbonic anhydride, the products of bacterial action upon sewage; and on the other hand they evolve quantities of oxygen which, dissolving in the water and oxidising organic matters, contribute to the purification of the sea and render it habitable by marine animals. Experimental proof of these statements is afforded, and coloured figures of the algæ cited are given.

Method of Analysing Plankton.†—L. Mangin describes a method of analysing the vegetable organisms of plankton, chiefly diatoms and Peridinieæ, these two differing profoundly in the nature of their membrane. The membrane of the Peridinieæ is of almost pure cellulose, while that of the diatoms has its organic part composed of pectic materials. For revealing the most minute structure of the cellulose wall of the Peridinieæ the best stains to use are the acid stains, while for pectic compounds the basic stains are best. By these methods

* Royal Commission of Sewage Disposal, Appendix vi. (1908) pp. 141–68 (pl.).
† Bull. Soc. Bot. France, lv. (1908) pp. 574–8.

the analysis of the plankton cannot be made in one operation; but two are necessary. For when, by the proper method, the diatoms are stained, the Peridinieæ remain colourless; and vice versâ. For the Peridinieæ Mangin employs iodised fuming hydriodic acid, followed by glycerinated chloral; the Peridinieæ become violet-brown and the diatoms are almost invisible. The operation can be completed by double staining with "azobleu," "azoviolet," or "azurine brillante." For the diatoms such stains as safranin, methylen-blue or old alum-hæmatoxylin may be used. Further stains and details of manipulation are described.

Methods of Plankton Research.* — W. J. Dakin publishes an account of the methods of plankton research, in which he describes and figures the construction of plankton nets, and describes the method of using the quantitative net; the preservation of the catch; the estimation of the catch; the pump, tube, and filter method; the method of investigation for the smallest organisms, as by the Krümmel water-bottle; other plankton apparatus used for qualitative work, as the Brutnetz, the Scherbrutnetz, the Knüppel net, the Plankton Röhre. And he gives an account of some results of the plankton work and of its aims, and concludes with a bibliography.

Marine Flora of Inland Salt Marshes.† — M. Gomont publishes a preliminary note on the marine algæ of Lorraine, that is, on the algæ which inhabit the salt marshes near Nancy, in the valley of the Seille, etc. Remote as the district is from the sea-shore, it exhibits a strong growth of *Lyngbya æstuarii* and *Microcoleus chthonoplastes*, which are characteristic of salt-works situated on the sea-coast. The list contains forty-six species and varieties. Owing to natural and artificial causes the degree of salinity of the water varies much and often. How the algæ have reached their inland situation is not discussed in the present paper.

Phyllosiphon Arisari.‡ — R. Maire makes some remarks on a parasitic alga (*Phyllosiphon Arisari* Kühn), which, in the Mediterranean region, occurs frequently during winter and spring on the leaves of *Arisarum vulgare*, forming yellowish-green to yellow spots, $\frac{1}{2}$–1 cm. in diameter. The filaments of the alga occupy the intercellular spaces and hinder the development of the chloroplasts; hence the yellow-green colour of the spots affected. Then the parasite provokes the secretion of yellow-orange oleaginous droplets in the cells of the host-plant; hence the spots turn yellow. Finally the leaf withers, the oleaginous droplets disappear, and the filaments of *Phyllosiphon*, now packed with green aplanospores, render the affected spots strikingly green on the colourless withered leaf. The same alga was found by Maire on *Arisarum simorrhinum* at Oran, in Algeria, and recently on *Arum maculatum*, near Lunéville, in France. Whether in the latter place it is natural or introduced, remains to be proved.

* Proc. and Trans. Liverpool Biolog. Soc., xxii. (1908) pp. 500–53 (figs.).
† Bull. Soc. Bot. France. lv. (1908) pp. xxix.–xxxiii. ‡ Tom. cit., pp. 162–4.

Form-variations in Cosmarium.*—J. Comère gives an account of some morphological variations of *Cosmarium punctulatum*, a Desmid which he has studied for some years and has cultivated in various media. He figures some characteristic variations of shape which it exhibits when growing in the natural state. It is easy to cultivate, and will even grow on nutritive gelatin. In concentrated Knopp solution the cells accumulate oil and starch and form hypnocysts. In sugar solutions the chromoleucites lose their colour and produce starch. In weak nutritive solutions zygospores (rare in the natural state) are formed ; in the absence of nitrates the zygospores are smooth ; but in the presence of nitrates and absence of phosphates, the zygospores are armed as in nature. In normal Knopp solution diluted, peculiar cysts are formed ; the cells fill themselves with oil and assume a reddish brown colour, and become surrounded with an envelope well defined outside, but mucilaginous and granulose within, the cells inside being solitary, paired, or usually in threes, of normal shape, and thus resembling certain Palmellaceæ.

Algæ of the Eppendorf Moor.†—M. Schmidt gives an account of the Eppendorf Moor, near Hamburg, with special reference to its algæ. He sketches its geographical position and features, and shows how it has served as shooting butts for a regiment. He proposes that it should be preserved as a natural park to save it from being drained and built over. He describes the remarkable flora which charcterises the moor, and calls special attention to the algal flora, which, in 1904, was shown by Heering and Homfeld to comprise 248 species. He gives a list of the rarer species and supplements it with some new records. The Diatomaceæ and Cyanophyceæ of the moor have not yet been investigated.

Fresh-water Algæ of Burmah and India.‡—W. and G. S. West give an account of a collection of fresh-water algæ made by I. H. Burkill mostly in Burmah and partly in Bengal and Madras during 1904. The number of genera comprised is 71, with 276 species and 16 varieties. New to science are 36 species and some varieties and also two genera, *Euastridium* and *Burkillia*. *Mougeotia producta* is of great interest as combining in its spore formation the characters of both *Mougeotia* and *Gonatonema*. And *Urococcus tropicus* is a green species of a genus in which the cells usually contain an abundance of a red-brown pigment. In addition to a list of some sixteen papers which have a more direct bearing upon the collection, the authors provide a general bibliography of ninety-eight items.

Fresh-water Algæ of Java.§—G. S. West publishes, under the title Botanical Synonyms in the Desmidiaceæ and Protococcoideæ, a series of criticisms and corrections of the determinations in a recent paper by C. Bernard upon Protococcacées et Desmidiées d'eau douce,

* Bull. Soc. Bot. France, liv. (1907) pp. xlii.–xlvi.
† Bot. Zeitung, lxvii. (1909) pp. 1–7.
‡ Ann. Roy. Bot. Garden, Calcutta, vi. (1907) pp. 175–260 (7 pls.).
§ Journ. of Bot., xlvii. (1909) pp. 60–64.

recoltées à Java.* Bernard enumerated 326 species and varieties, and illustrated them with 580 figures. He described two new genera and eighty-seven new species and varieties, and appended a bibliography of ninety-three works. West complains of the inaccuracy of many of Bernard's figures and of the absence of many necessary side and vertical views. He also complains that Bernard apparently has omitted to consult sundry important works on the Desmids of Britain, tropical Africa, South America, Koh Chang in Siam, and Burmah. West first reduces or condemns thirty of Bernard's new species, and then points out the inaccuracy of some forty-five other determinations.

Desmids of Sydney, N.S.W.†—G. I. Playfair publishes some descriptions and figures of Desmids collected in the suburbs of Sydney. Among them are five new species and thirty-six new varieties or forms. One of the localities, Coogee, is a small *Sphagnum* bog with a distinctive Desmid flora abundant in late autumn, April and May.

Yorkshire Diatoms.‡—M. H. Stiles gives a list of eighty-six species and varieties of diatoms collected in fresh-water at four stations by members of the Yorkshire Naturalists' Union during their July excursion to Hampole near Doncaster.

Metachromatic Bodies in Vaucheria.§—G. A. Nadson and L. P. Brüllowa describe the occurrence of numerous metachromatic bodies in *Vaucheria repens*. They occur among the cell nuclei. The material was fixed in iodised alcohol, and the bodies can be demonstrated by staining with hæmatoxylin, or better by staining with methylen-blue and decolorising with 1 p.c. sulphuric acid. In the past the bodies have been mistaken for smaller nuclei or for degenerated nuclei. Their nature is quite unknown.

Invasion of Colpomenia sinuosa.‖—C. Sauvageau gives a further account of the appearance, prevalence and disappearance of *Colpomenia sinuosa* in the oyster-beds of France. He has now ascertained that even before 1906 the alga had been noticed in the oyster-parks near Vannes—for several years in fact, but in small quantity. It was only in 1906 that the formidable multiplication of this plant took place and wrought havoc in the oyster-beds. It spread to Cherbourg and St. Vaast, and even to Torquay and Swanage in 1907. In June 1908 it again abounded at Cherbourg, producing remarkably large specimens (15 cm.). In August 1907 some small specimens of it were found on a wreck at Wimereux, indicating a possible means of transport for the alga. In September 1907 small very fertile specimens attached to *Cystoseira ericoides* were collected at Croisic. At Seudre the plant is unknown. At Vannes in 1907 when it threatened another invasion it was soon stifled out of existence by a profuse development of *Enteromorpha clathrata* 30 cm. long, covering oysters and substratum, so that in the spring of 1908 not a *Colpomenia* could be found.

* Dep. de l'Agriculture, Batavia (1908) 230 pp., 16 pls. See also this Journal, 1908, p. 739. † Proc. Linn. Soc. N.S.W., xxxiii. (1908) pp. 603–28 (3 pls.).
‡ Naturalist, No. 621 (1908) pp. 383–4.
§ Bull. Jard. Impér. Bot. St. Pétersbourg, viii. (1908) pp. 159–64 (figs.).
‖ C.R. Hebdom. Soc. Biol. Paris, lxv. (1908) pp. 751–3.

Fucus platycarpus and F. lutarius.*—C. Sauvageau writes with much detail about two species of *Fucus* collected at Arcachon—*F. platycarpus* and *F. lutarius*. 1. He shows that the name *F. spiralis* Linn. has no precise meaning, and cannot be used to replace *F. platycarpus* Thuret, a southern species, with which must be united the *F. spiralis*, *F. Areschougii*, *F. Sherardi*, *F. versoides* of authors. *F. versoides* has been accidentally introduced into the Adriatic and become naturalised. Sauvageau proposes three varieties of *F. platycarpus*, namely, *typica*, *spiralis*, and *limitaneus*. 2. As to *F. lutarius* Kuetz., he holds it to be worthy of specific rank. It grows on mud, or on bunches of littoral phanerogamic plants where protected from desiccation by Chlorophyceæ. The spiral frond possesses numerous piliferous crypts. The type possesses no acrocysts, however, in the north of Spain, and in England vesiculiferous specimens are found. He separates off from it the new variety *arcassonensis*. He suggests that histological researches may serve to settle the real affinities of the limicolous forms of *Fucus*.

Cytology of Porphyra.†—S. M. Wislouch treats of the anatomy of the cell in *Porphyra*, and confirms the observations of previous investigators as to the structure of the cuticle and cell-membranes. The cell-wall appears to be composed of hemi-cellulose, inasmuch as it responds negatively to cellulose reactions. He gives some new figures of the chromatophores, and describes a radiating type of structure not previously observed in them. The large roundish body situated in the centre of the cell, hitherto supposed to be the nucleus, is the pyrenoid of the chromatophore. The real cell-nucleus is very much smaller, 1·5–2 μ, and lies sideways between the cross-divisions of the chromatophore. The author corrects the views of Haberlandt as to the position of the nucleus in the basal cells—those which bear rhizoidal protuberances. The nucleus is situated in the older part of the cell, and not in the actively growing part.

Ceramium radiculosum, a Brackish-water Species.‡—J. Schiller treats of the morphology and biology of *Ceramium radiculosum* Grun., one of the few red algæ which have established themselves in brackish-water. It occurs above the mouth of the river Timavo near Monfalcone, on the Adriatic. He describes and figures its structure, and carefully considers its distribution and the physical factors of its environment. He shows that it ascends the river as far as the brackish-water goes at flood tide, and that it descends towards the river mouth at least as far as the fresh-water penetrates during the ebb: and that during the twenty-four hours the plants are thus twice washed over by fresh-water and twice by brackish-water. He shows that the values of the salinity of the water of the two periods lies between 0·05 and 2·85 p.c.; and that the alga requires that the water shall be quick flowing, clean and not above 20° C. He describes also the formation of the rhizoids by which the *Ceramium* splits open the tissue of the plant which serves as matrix—*Zostera*, *Scirpus*, *Potamogeton*, or *Enteromorpha*.

* Bull. Stat. Biol. Arcachon, 1908, 160 pp.
† Bull. Jard. Impér. Bot. St. Pétersbourg, viii. (1908) pp. 89–101 (figs.).
‡ Oesterr. Bot. Zeitschr., lviii. (1908) pp. 49–54, 111–18 (1 pl. and figs.).

Irish Algæ.*—J. Adams has prepared an account of the algæ for the Dublin Handbook of the British Association. He shows that in the Handbook of the Meeting at Dublin in 1878 the total algal flora was 844 fresh-water species and 440 marine; to these have since been added 24 fresh-water and 114 marine, making a present grand total of 1422 species. The author gives a list of the rarer species:—Cyanophyceæ (8), Chlorophyceæ (17), Conjugatæ (5), Diatomaceæ (8), Phæophyceæ (5), Rhodophyceæ (11). And he appends a bibliography.

North American Algæ.†—F. S. Collins publishes his ninth article of notes on algæ. *Glœocystis scopulorum*, a European species which he has found in a warm-water pool in Maine, he thinks may prove to be a stage of *Ulothrix* or *Urospora*. *Protococcus ovalis* was found with the last species. *Pilinia endophytica* is described as a new species growing endophytically in *Ralfsia Borneti* in Maine and all along the New England coast. *Pringsheimia scutata* is a minute epiphyte found on *Zostera* in Massachusetts. *Ochlochæte ferox* growing with the last species is a new record for North America. *Sphacelaria fusca*, the difference of which from *S. cirrhosa* was lately made clear by Sauvageau, has been found by Collins growing on a spider-crab in Massachusetts. *Petrocelis Middendorfii* is shown to be the name of the *Petrocelis* of the New England coast, hitherto supposed to be *P. cruenta*. The author describes the remarkable algal vegetation observed during the summer in two northerly stations, and discusses the conditions affecting them, viz. warmth, increasing salinity, etc. He says, in summing up, that "even on shores where conditions are sub-arctic individual stations may be found where the conditions for a short time are almost sub-tropical; in such stations the number of species must be limited, but the number of individuals developed in a short time may be enormous; they will be mostly plants of very rapid development and of short life, and mostly of quite low organisation; some plants, common in the sub-arctic waters, may here assume a sudden luxuriance (*Chondrus*); some may also appear on a different substratum (*Ralfsia*); some may take on a habit so distinct as to be considered a separate species native to lower latitudes (*Chætomorpha*)."

R. E. Buchanan ‡ enumerates the algæ recorded for Iowa, including 180 species, and provides keys for the easier determination of the plants.

Indian Ocean Algæ.§—A. and E. S. Gepp give an account of the Chlorophyceæ and Phæophyceæ collected by J. S. Gardiner during the 'Sealark' Expedition to the Seychelles, Chagos Archipelago, and the adjacent islands of the Indian Ocean in 1905. The list contains thirty-six green and thirteen brown algæ; and six of them are new to science. *Microdictyon pseudohapteron* is peculiar in the tenacula which bind together its network. *Bryopsis indica* was distributed by W. H. Harvey fifty years ago, but without a specific name. *Cladocephalus excentricus* is an eastern member of a West Indian genus. Two new

* Handbook to the Dublin District, Brit. Assoc., Dublin, 1908, pp. 102–8.
† Rhodora x. (1908) pp. 155–164.
‡ Proc. Iowa. Acad. Sci., xiv. (1908) 40 pp.
§ Trans. Linn. Soc. (Bot.) vii. (1908) pp. 163–88 (3 pls.).

species of *Struvea* and an *Avrainvillea* are the other novelties. The genus *Tydemania* had only once before been collected. *Udotea palmetta* Decaisne, also but once found previously (sixty-five years ago), had been a standing puzzle of unknown origin. Gardiner has now dredged up specimens from a depth of 45 fathoms. *Udotea argentea* Zan., the type of which has been lost, and *Avrainvillea amadelpha*, wrongly placed in *Udotea*, are elucidated. Propagation by means of stolons in *Turbinaria* is demonstrated.

Algæ of New Zealand and Norfolk Islands.—R. M. Laing* publishes a note on the occurrence of *Phyllitis fascia* (Muell.) Kuetz. in New Zealand. He found it at Akaroa, and submitted it to T. Reinbold and to W. A. Setchell. The latter found plurilocular sporangia upon it. The plant was unknown in Australia, but had been recorded for Cape Horn and the Falkland Islands, its distribution otherwise being in the northern hemisphere. In a postscript Laing announces the occurrence of the plant at Wellington Heads, and in a list of New South Wales algæ.

The same author † publishes an appendix of six marine species to his list of seaweeds of Norfolk Islands which appeared in the thirty-third volume of the Transactions. The previous list contained thirty-three species, one of which, *Plocamium hamatum* J. Ag., supposed at the time to be endemic, has since been found on the Australian coast.

Japanese Algæ.‡—K. Okamura publishes the ninth part of his Icones of Japanese Algæ, including the following plants:—*Dudresnaya japonica* Okam. sp. n.; *Halicoryne Wrightii* Harv.; *Bornetella capitata* (Harv.) J. Ag.; *Udotea conglutinata* (Soland.) Lamour; *Udotea javensis* (Mont.) Gepp—some of which are now adequately figured for the first time. *Dudresnaya japonica* is illustrated in considerable detail, the development of the cystocarp from the procarp onwards being shown in various stages. The other species are well illustrated. The descriptions are in Japanese and English.

Liasophycus, a New Fossil Alga.§—P. Fliche publishes an account of a fossil alga found by M. Joly in the upper "Sinémurien" of Rimogne (Ardennes). It is a large branched cylindrical thallus bearing elliptical fructifications along one side. It resembles most nearly the Australian *Scytothalia dorycarpa* Grev., except that in its fruits it approaches *Seirococcus axillaris* Grev. Its structure is preserved and shows itself to be purely cellular, as in the Fucaceæ. It is named *Liasophycus scytothalioides*, its origin in the Lias being commemorated in the generic name. It appears to be the oldest indisputable alga that has come down; for in those recorded as occurring in the Trias the microscopic structure is unknown.

* Trans. Proc. New Zealand Inst., xxxix. (1907) pp. 220–1.
† Op. cit., xxxviii. (1906) p. 424.
‡ Icones of Japanese Algæ, i. No. 9 (1908) pp. 209–32 (pls. 41–5).
§ Comptes Rendus, cxlviii. (1908) pp. 210–12.

Bory de Saint-Vincent.*—C. Sauvageau gives an account of the life of J. B. Bory de Saint-Vincent (born 1778, died 1846), mainly founded on the Correspondence of Bory with Léon Dufour, recently published by P. Lauzun.† Bory's chequered existence is sketched out: His voyage in 1799 to Madeira, the Canaries, Cape Verde Islands, Mauritius and Bourbon; his long service in the Napoleonic armies in France, Germany, Austria, Poland; his visits to distinguished naturalists in those countries; his service in the Peninsular War; the collections which he always made during the campaigns: his enforced residence abroad after Waterloo; his pardon and return to France in 1820; his encyclopædic and other writings; his imprisonment for debt in Sainte-Pélagie from time to time—periods of great botanical and literary activity. After his death his Algæ were purchased by Thuret, in whose herbarium they remain.

Fungi.

(By A. Lorrain Smith, F.L.S.)

Spread of Phytophthora infestans, with special reference to Hibernating Mycelium.‡—A. H. Cockayne states that the disease of potatoes, due to this fungus, was first reported some twelve years ago in New Zealand, and ascribes its occurrence to the importation of potatoes in which the mycelium of *Phytophthora* was present. A slice of potato in which the mycelium has been demonstrated, and which is kept moist, develops immediately hyphæ and conidiophores, showing, as Cockayne points out, that the fungus is not truly in a dormant condition, but on the border line between active and hibernating mycelium; it can thus become active without further growth of the host-plant. Cockayne also draws attention to the fact that the mycelium in the tuber, when growth begins, is negatively geotropic and makes its way to the stalk and leaves; but when infection takes place from spores on the leaves, it is positively geotropic, and passes down to the developing tubers to which it is probably attracted by the store of food material.

Winter Stage of Sclerotinia fructigena.§—J. B. Dandeno tried to cultivate the *Peziza* form of this fungus from plums attacked by the conidial stage *Monilia fructigena*. It was found that plums on the top of the soil dried up, or were destroyed by rain, etc., and those that were entirely buried rotted away. The fruiting stage, however, was produced abundantly on plums that were only partially buried. This suggested a sure method of destroying the winter stage by ploughing in all the diseased plums in the autumn. The *Monilia* form may survive the winter, but it would be a clear gain to destroy the alternative stage of the fungus.

Fraudulent Substitutions for Truffles.‖—R. Maire was asked to examine a sample of truffles, and found that, instead of *Tuber*

* Journ. de Bot., xxi. (1908) pp. 198–222.
† Agen, 1908; 358 pp. (2 portraits).
‡ Trans. and Proc. New Zealand Inst., xl. (1907) pp. 316–20.
§ Tenth Rep. Mich. Acad Sci., 1908, pp. 51–3 (3 figs.).
‖ Bull. Soc. Bot. France, lv. (1908) pp. xxxiv.–vi. (1 fig.).

melanosporum which they professed to be, they were specimens of *Chæromyces meandriformis*, an underground fungus rare in France, but very common in Silesia, Bohemia, and Galicia. The substituted species is white, but it had been stained black to imitate the true truffle; it is edible, but very inferior in flavour to *Tuber melanosporum*.

Geoglossaceæ of N. America.*—Genera and species of this group of fungi in America, are abundant and varied, and closely related to those of other countries. E. J. Durand has written a monograph based on American forms, and comprising eleven genera. He has been able to describe fresh material in almost every case, and he has also been able to examine the type specimens from the various herbaria of the world. The group falls into two divisions: those with (1) the ascoma clavate or spathulate, and (2) with the ascoma pileate. Colour and spore form serve to distinguish the genera from each other. Durand's observations have confirmed Dittrich's statement, that the young ascomata of *Mitrula phalloides* and *Leotia gelatinosa* are covered by a veil, thus giving the hymenium an endogenous origin. He notes the same occurrence also in *Microglossum viride*, *Spathularia velutipes* and *Cudonia lutea*. So far the veil has been demonstrated in five genera. Descriptions of locality and habitat are given, and the systematic part includes full diagnoses of species.

Contribution to the Study of Endomyces.†—A. Guilliermond undertook a study of *Endomyces fibuliger*, to trace, if possible, the affinity between that fungus and *Saccharomycopsis capsularis*, one of the yeasts. He cultivated both fungi on carrots, and found that both produced a septate mycelium (each cell of the hyphæ containing one nucleus), as well as a large number of yeast conidia. After six or eight days, asci were formed on the terminal cells of the hyphæ. Lindner had noted frequent anastomosis between the cells of the hyphæ. Guilliermond verifies this, and finds that it takes place always before ascus formation. No nuclear fusion was observed; the anastomosis may be the vestige of isogamic conjugation. Other cytological phenomena are described by the author, all tending to confirm this theory of the affinity of the two fungi.

Erysiphaceæ.—E. Mayor ‡ has given many years of study and observation to this order of fungi in West Switzerland, particularly in the Jura. He has found in this comparatively limited neighbourhood, representatives of nearly all the European species. He follows Salmon's classification and grouping. For *Erysiphe Polygoni* he records eighty-five hosts, for *E. chicoracearum*, forty-nine.

E. S. Salmon § records and describes a new species of *Uncinula* from Gazaland, collected by C. F. M. Swynnerton. It differs from other species in the stouter and larger appendages.

Indigenous Yeasts of Java.‖—Wild yeasts are plentiful in Java, and are more frequently found on decaying leaves than on fruits.

* Ann. Mycol., vi. (1908) pp. 387–477 (18 pls.).
† Comptes Rendus, cxlvii. (1908) pp. 1329–31.
‡ Bull. Soc. Neuchât. Sci. Nat. xxxv. (1908) pp. 43–61. See also Bot. Centralbl. cviii. (1908) pp. 658–9.
§ Ann. Mycol., vi. (1908) p. 525.
‖ Centralbl. Bakt., xxi. (1908) p. 66. See also Bot. Centralbl. cviii. (1908) p. 631.

E. de Kruyff explains this by stating that the people of Java seldom allow the fruits to ripen on the trees for fear of thieves. He has isolated seven species of *Saccharomyces* and one of *Zygosaccharomyces* (*Z. javanicus* sp. n.). All of them ferment glucose, most of them also saccharose and maltose, none of them affect lactose. *Saccharomyces apiculatus*, so common in Europe, was not found; *Torula* yeasts were rare, but a red *Torula* was frequently met with. Three samples of soil from Krakatoa gave no yeasts.

Rust-eating Larvæ.*—Laubert took note of the constant presence of small red larvæ on rusted plants, and found that they fed on the fungus spores. These larvæ form their chrysalids on the leaves and cover them with a flat white web. After a short time a dipterous insect is produced. Laubert considers of great economic importance the presence of this constant enemy of the rust plant.

British Basidiomycetes.†—A handbook of British basidiomycetous fungi by Worthington G. Smith has recently been issued by the Trustees of the British Museum. The descriptions were drawn by Smith when preparing the fine series of water-colour drawings exhibited in the Botanical Department. In the introduction the author gives a general sketch of the development and life-history of the group, with notes on habitat and locality. The system and sequence adopted by Fries has been mainly followed in the arrangement of natural orders, genera, etc. The descriptions of each species contain the salient distinctive characters which must be used along with the generic and sectional characters given as keys at the head of each genus. All repetition is avoided, and the book is thus kept within a comparatively small compass, though the species described amount to well over 2000. The Agaricaceæ is the largest natural order, containing about 1450 British species. The Polyporaceæ, Hydnaceæ, etc., and the Gasteromycetes are also fully dealt with. There is also a useful glossary of technical terms, and a full index. The different groups as well as the separate genera are illustrated by line engravings also by W. G. Smith, and a colour key to the Agaricaceæ is added.

Edible and Poisonous Fungi.‡—J. Röll publishes descriptions and plates of fungi used for food in Germany. The plates have been prepared from drawings by Frau Schultze, and are reproduced in natural size. Information to assist the collector is provided, with locality, season of growth, etc. An account is also given of the methods of collecting and preparing the fungi; and information as to mushroom culture is added.

G. F. Atkinson § describes and figures an Agaric, *Tricholoma venustum* sp. n. which had been eaten by a number of people and had caused considerable trouble, though none of the cases proved fatal. Odour and taste were mild.

* Deutsche Landw. Presse, 1907, p. 618. See also Centralbl. Bakt., xxii. (1908) p. 181. † Brit. Mus. (Nat. Hist.) (1908) 531 pp. (145 figs. and 5 pls.).
‡ Tubingen: H. Laupp, 1908 (14 pls., 3-col. process). See also Bot. Centralbl., cviii. (1908) p. 659. § Bot. Gaz., xlvi. (1908) pp. 461–3 (2 figs.).

Uredineæ.—R. Probst* has continued the work undertaken but not completed by E. Jacky, on the infection of Compositæ with *Puccinia Hieracii*. Jacky had proved that it was a compound species. One of the forms, *P. Leontodontis*, proved to be very varied in the appearance of the teleutospores, and Probst instituted a series of inoculation experiments with species of *Leontodon*, *Hieracium*, and *Hypochæris*. The material was taken from *L. hispidus*, and he found that neither *Hieracium* nor *Hypochæris* was liable to infection. Other forms recognised by Jacky as distinct, *P. Hypochæridis* and *P. carduorum*, were found to give somewhat similar results, i.e. their power of infection was limited to certain species of *Hypochæris* or *Carduus* respectively.

S. Kusana † describes some rusts that attack *Chrysanthemum*. The first, *Puccinia Chrysanthemi*, the black rust, appeared some years ago, and did great damage to the plants in Europe and America. It has been determined as identical with the rust of *Chrysanthemum* in Japan, but Kusano indicates several points of difference between the two forms. In the European, the uredospores winter on the young shoots in greenhouses, and teleutospores are rare. In Japan the uredospore is followed regularly by the teleutospore, though in warm neighbourhoods the uredo-stage persists. The formation of 2-celled uredospores and of mesospores is also described by the author as occurring both in Japan and in Europe. Kusano ascribes these variations of spore-formation to the differences in locality and temperature. The white rust, *P. Horiana*, forms large white waxy sori, and is more injurious than the black rust, but it does not attack all forms of *Chrysanthemum*. There is, further, a brown rust, *Uredo autumnalis*, common in the warmer regions of Japan, and of which only the uredospore form is known. It occurs on several species of *Chrysanthemum*. Kusano thinks that these rusts, though somewhat specialised to different hosts, originated on *Chrysanthemum Decaisneanum*.

J. C. Arthur ‡ defends his new classification of the Uredineæ against various mycologists who have criticised the changes he has made. He pleads that further knowledge has necessitated the splitting up and rearranging of such genera as *Uromyces* and *Puccinia*, and he holds that recent research on the nuclei of the different generations in the rusts prove the correctness of his scheme.

P. Hariot § has published an account of French Uredineæ in a volume forming part of the Encyclopédie Scientifique. There are two sections of the work, the first dealing with morphology, etc., the second with an account of the classification of the species occurring in France.

Ed. Fischer ‖ publishes an account of experiments made with *Æcidium homogynes* Schrœt., the teleutospore form being *Uromyces Veratri*. This fungus has been found on *Homogyne alpina* and *Adenostyles alpina*. Fischer, as a result of his inoculation experiments, concludes that there are two Uredines concerned, *Adenostylis* sp. and *Homogynes* sp., both being biological forms of *Uromyces Veratri*.

* Ann. Mycol., vi. (1908) pp. 289–300. † Tom. cit., pp. 306–12.
‡ Tom. cit., pp. 326–30.
§ Bibliothèque Bot. Crypt. Paris: O. Doin, 1908, 387 pp. (47 figs.). See also Ann. Mycol., vi. (1908) p. 363.
‖ Centralbl. Bakt., xxii. (1908) pp. 89–96 (3 figs.).

Polyporus lucidus and some of its Allies.*—G. F. Atkinson has made a study of the forms of this fungus that have been found in Europe and North America. He remarks on the general resemblance there is between the floras of the two countries, especially among fungi, though often there is a slight modification, almost amounting to specific difference, to be observed. Thus while *P. lucidus* occurs in Europe almost solely on frondose trees, in America its chief habitat is the hemlock-spruce, otherwise it is exactly like the European species. Atkinson describes *P. lucidus* under Murrill's name *Ganoderma pseudo-boletum*, and also the two allied forms, *G. Curtisii*, which is rarely varnished, *G. oregonense* Murrill and *G. subperforatum* sp. n. Notes are given of the spores of these species. They are not verrucose as frequently described, but dotted with projections of the central contents.

German Corticeæ.†—F. v. Höhnel and V. Litschauer continue their study of Corticeæ from various parts of Germany. From Westphalia are recorded forty-one species belonging to *Corticium*, *Peniophora*, *Tomentella* and other genera. Several species are new or redescribed; eighty-nine species have been found in North Germany; the account of them is now concluded. The habitat and locality are appended in all cases.

Abnormal Formations in Hymenomycetes.‡—F. Ludwig considers that the malformations of the Higher Fungi so frequently described are a means of increasing the hymenial tissue of the plant, and aid in the dissemination of spores. He cites three typical instances. 1. The formation of stalked heads one above the other, occurring in *Lactarius volemus*, *Russula rubra*, other species of *Russula*, and in some *Boleti*. 2. Polycephalous formation: many little heads on one stalk, found in *Hydnum repandum* and normal in *Polyporus umbellatus* and *P. frondosus*. 3. Polyporoid formation in gilled fungi, which occurs in *Agaricus campestris*, *Paxillus involutus*, and *Cortinarius*. The author thinks that some genera such as *Pterophyllus* and *Rhacophyllus* have been founded on a mistaken appreciation of malformations.

Research on Elaphomyces.§—E. Fontana has examined a large number of specimens, and publishes a revision of this genus. She gives prominence to the characters of the peridium and especially the sculpturing of the surface as being of value in determination.

In a second paper ‖ she compares *E. anthracinus* and *E. pyriformis* and concludes that these two represent but one species, *E. anthracinus*, with perhaps a form, *pyriformis*. She found in Vittadini's collections three specimens of the very rare *E. septatus*, and now writes a detailed description of it.

* Bot. Gaz., xlvi. (1908) pp. 321–38 (1 pl. and 5 figs.).
† Oesterr. Bot. Zeitschr., lviii. (1908) pp. 329–35; 441–4; 470–8.
‡ Festschr. Welt. Ges. Gesammt. Naturk. Hanaw., 1908, pp. 112–17. See also Bot. Centralbl., cviii. (1908) pp. 607–8.
§ Mem. R. Accad. Sci. Torino, ser. 2, lix. (1907–8) pp. 89–108 (2 pls.).
‖ Atti R. Accad. Sci. Torino, xliii. (1907–8). See also Bot. Centralbl., cviii. (1908) p. 610.

Notes on Aseroë.*—Specimens belonging to this tropical genus of Phalloideæ have been found in Java by Ch. Bernard, who publishes descriptions and drawings. The plant was found in a tea plantation in considerable numbers, and proved to be *A. rubra* var. *Junghuhnii*, about 7 cm. in height, diameter of the crown 9–10 cm., mostly salmon coloured, changing to a blood-red colour at the top of the stalk. The mucilaginous spore-mass was chocolate-brown, and of a somewhat disagreeable odour. The author remarks that only after examination of many individuals can one determine the limits of species and varieties, as one can thus fill up lacunæ with intermediate forms which give a well connected series. Fischer had retained the above plant as a separate species, but was inclined to consider it as only a variety of *A. rubra.*

Fungi of Nova Scotia.†—A. H. Mackay publishes a supplement to the provisional list of fungi for this colony. Some notes are introduced on poisonous species. *Psilocybe fœnisecii* was supposed to have been eaten by some children who betrayed symptoms of nervous trouble, suggestive of belladonna poisoning. Another case of poisoning due to *Panæolus papilionaceus* is reported: the patient suffered from dizziness and dimness of vision, but recovered after a few hours. A fatal case, supposed to be due to an *Amanita*, is also recorded. The writer of the note adds that in twenty years he has only seen two cases of fungus poisoning in a district where fungi are eaten very freely.

Mycological Research.‡—O. Brefeld has recently issued another volume, the 14th of his great work on Fungi. He discusses the artificial culture methods employed in the study of these plants, and the problems in mycology that have been solved by this means. Many are still awaiting solution, especially among the Fungi imperfecti, which are mostly stages of some higher fruit form. For each group of Fungi he gives the best methods of inducing spore-germination and subsequent developments, and gives an account of the progress achieved by workers in each separate branch of the subject. The whole field of mycology has been reviewed by the author.

Handbook of Technical Mycology.§—The second volume of this great work by Lafar has been recently completed. Most of the volume is concerned with other than botanical subjects, but the later chapters are devoted to the mycology of sugar-making and bakeries. The organisms concerned in the different processes—syrups, molasses, etc., and the causes that affect them disadvantageously, are discussed. Similarly the ferments connected with bread-making are dealt with, those causing acidity, discolorations, etc., and the occurrence of ergot are also described.

Necessity of Precision in the Diagnosis of Moulds.‖—L. Mangi has concluded, from his study of *Aspergillus*, that allowance must be

* Ann. Jard. Bot. Buit., xxii. (1908) pp. 225–37 (2 pls.).
† Proc. Trans. Nova Scotia Inst. Sci., xii. (1908) pp. 119–38.
‡ H. Schöningh, Münster-i.-W. (1908) 256 pp.
§ Handbuch Technischen Mykologie, Lief. 18 (Jena, 1908). See also Bot. Centralbl., cviii. (1908) pp. 631–2.
‖ Bull. Soc. Bot. France, lv. (1908) pp. xvii.–xxix. (1 pl. and 2 figs.).

given for variations due to environment, etc., when diagnosing moulds. He found that their form, size, etc., varied considerably according to the medium in which they grew, and also according to the temperature. The ornamentation of the spores was liable also to great transformation; with a rising temperature the markings or spines tended to disappear. The author gives comparative figures of the spores of different species, which serve to accentuate the importance of his statements.

Pathogenic Aspergillus.*—G. Bainier and A. Sartory describe a new form of *Aspergillus* closely allied to *A. fumigatus*, but differing in aspect and colour and in various other respects. It was pathogenic for certain animals (hares, etc.) which died in six days after the fungus had been injected. Details are given of the effects on the animals.

Vegetable Pathology.†—Vittorio Peglion has studied the dissemination of the disease of cereals caused by *Sclerospora*. He finds that this is achieved by the presence of the mycelium of the fungus under the outer coating of the seed. He sowed seeds taken from a diseased head without having treated them in any way. A number of the seeds never germinated: those that grew presented abnormal characters, and microscopic examination proved the presence of mycelium in the younger parts of the plants.

Plant Diseases.—E. G. Roques ‡ describes three parasitic fungi which he found on plants in the Pyrenees: *Fusicladium Aronici* formed brown spots on the under side of leaves of *Aronicum scorpioides*; *Synchytrium aureum* was signalled on four new hosts: *Hutchinsia alpina*, *Galium cæspitosum*, *Oxytropis pyrenaica*, and *Phyteuma spicatum*. *Pyrenophora chrysospora* was found in great abundance on the leaves of *Saxifraga aizoides*. It is the same fungus as that reported from Spitzbergen by Karsten, probably dating from the time of the glaciers, and is thus a Pyrenean mycological record of Pleistocene ages.

C. Spegazzini § contributes an account of pests of cherry trees in Argentina. He describes three new species of fungi on the leaves.

Ch. Bernard ‖ supplied notes on vegetable pathology in the East Indies, and describes pests of *Citrus*, Tea, Vanilla, etc. A number of new species of parasitic fungi are described.

A further paper ¶ by the same writer deals with the pests of plants, *Hevea*, *Ficus*, *Castelloa*, *Kicksia*, and *Manihot*, from which rubber is obtained. One of the most deadly is *Corticium javanicum* on the roots of *Hevea*.

BOKORNY, TH.—**Einiges über die Atmung der Hefe unter verschiedenen Bedingungen.** (On the respiration of yeast in different circumstances.)
Allg. Brauer-Hopfenzeit (Aug. 1908).
See also *Centralbl. Bakt.*, xxii. (1908) pp. 122–3.

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* C.R. Soc. Biol. Paris, lxvi. (1909) pp. 22–3.
† Atti Reale Accad. Lincei, cccv. (1908) pp. 509–11.
‡ Bull. Soc. Bot. France, liv. (1907) pp. 141–6.
§ Cron. Agric., ii. (1908) pp. 33–40 (5 figs.). See also Ann. Mycol., vi. (1908) p. 500.
‖ Bull. Dep. Agric. Indes. Neerl., xi. (1907) 55 pp. (3 pls.). See also Ann. Mycol., vi. (1908) p. 500.
¶ Op. cit., xii. (1907) 79 pp. (2 pls.). See also Ann. Mycol. vi. (1908) p. 500.

BUCHOLTZ, FEODOR—**Zur Entwicklung der Choiromyces. Fruchtkörper.** (The development of the fruiting-bodies of *Choiromyces*.)
Ann. Mycol., vi. (1908) pp. 539–50 (1 pl.).

GASSNER—**Estudio sobre los hongos de la Republica O. del Uruguay, especialmente de los parasitos.** (Study of parasitic fungi of Uruguay, especially of parasites.) *Rev. Sec. Agr. Univ. Montevideo*, 1907.
See also *Centralbl. Bakt.*, xxii. (1908) p. 148.

GIESENHAGEN, K.—**Bemerkungen zur Pilzflora Bayerns.** (Notes on the fungus flora of Bavaria.) *Ber. Bayer. Bot. Ges.*, xi. (1907) pp. 163–70.
See also *Ann. Mycol.*, vi. (1908) p. 495.

GUÉGUEN, FERNAND—**Sur un Oospora nouveau.** (On a new *Oospora*.)
[A tongue disease caused by the presence of *Oospora lingualis* sp. n.]
Comptes Rendus, cxlvi. (1908) pp. 994–6.

HENNING, P.—**Fungi von Madagaskar, den Comoren und Ostafrika.**
[The fungi of Voeltzkow's journey in East Africa in the years 1903–5. Many new species are described, and one new genus, *Voeltzkowiella* (Discomycete). Stuttgart: iii. (1908) 33 pp. (2 pls.).
See also *Ann. Mycol.*, vi. (1908) pp. 495–6.

HÖHNEL, FR. V.—**Eumycetes et Myxomycetes.**
[Fungi from South Brazil, collected by Wettstein and Schiffner, 187 species. There are many new species; the new genera are *Wiesnerina* (Thelephoreæ), *Actinopeltis* (Pyrenomycete), *Staurophoma* and *Peltistromella* (Sphæropsideæ), *Pseudogaster* and *Stromatographium* (Hyphomycetes).
Denkschr. Math. Nat. Kl. k. Akad. Wiss. Wien, lxxxiii. (1907) 45 pp. (1 pl.). See also *Ann. Mycol.*, vi. (1908) pp. 497–8.

KEISSLER, KARL VON—**Ueber Beloniella Vossii Rehm.**
[A discussion of synonymy and description of the plant.]
Ann. Mycol., vi. (1908) pp. 551–2.

LUTZ, L.—**Un champignon nouveau de l'Afrique orientale portugaise.** (A new fungus from Portuguese East Africa.)
[A species of *Psilocybe*, of which the spores or mycelium had been imported with palm seeds.] *Bull. Soc. Bot. France*, liv. (1907) pp. 191–2 (1 fig.).

MAFFEI, L.—**Contribuzione allo studio della micologica ligustica.**
[Contribution to the mycological flora of Liguria.]
Atti Ist. Bot. Pavia, ser. 2, xii. (1907) 16 pp. (1 pl.).
See also *Ann. Mycol.*, vi. (1908) p. 498.

MASSEE, G.—**The Fungus Flora of New Zealand. Part II.**
[A list of species belonging to Polyporeæ, Tremellaceæ, etc., with diagnoses and habitat.] *Trans. New Zealand Inst.*, xxxix. (1906) pp. 1–49 (2 pls.).

MATTIROLO, O.—**Seconda contribuzione allo studio della flora ipogea del Portogallo.** (Second contribution to the study of the underground fungi of Portugal.)
Boll. Soc. Brot., xxii. (1906) pp. 227–45, Coimbra, 1907 (1 pl.).
See also *Ann. Mycol.*, vi. (1908) p. 498.

" " **Species novæ in excelsis Ruwenzori in expeditione Ducis Aprutii lectæ VI. Mycetes.** (New species from the Duke of Abruzzi's expedition to Ruwenzori.)
[One new genus, *Aldysiella* (Pyrenomycete), is described from living branches of *Erica arborea*.
Ann. di Bot., vii. (1908) pp. 143–5.
See also *Ann. Mycol.*, vi. (1908) pp. 498–9.

MURRILL, W. A.—**Boleti from Western North Carolina.**
[Species of *Boletus*, *Boletinus*, *Fistulina*, and *Strobilomyces* were found. One new species, *Boletus Vanderbiltianus*, is described.]
Torreya, viii. (1908) pp. 209–17.

NAMYSLOWSKI, B.—**Wawelia regia, subfam. et g. n.**
[On the structure and development of *Wawelia*, a genus of Hypocreaceæ, found on hare dung.]
Bull. Acad. Sci. Cravovie, 1908, pp. 597–603 (6 figs.).
See also *Ann. Mycol.*, vi. (1908) p. 199.

" " **Fungi novi aut minus cogniti.** (New or rare fungi.)
[Several species of microfungi (parasitic) are dealt with.] *Kosmos*, 1908, p. 328–30.
See also *Ann. Mycol.*, vi. (1908) p. 199.

REHM, H.—**Die Dothideaceen der deutschen Flora.** (German Dothideaceæ.)
[Descriptive list of the genera and species.]
Ann. Mycol., vi. (1908) pp. 513–24.

" " **Ascomycetes exs. Fasc. 42.**
[Nos. 1776–99 are listed, with notes and descriptions of new species. Most of them are from Brazil.]
Tom. cit., pp. 484–91.

ROUPPERT, C.—**Discomycetum species novæ tres.**
[Diagnoses of three new species of Discomycetes.]
Bull. Acad. Sci. Cracovie, Cl. Sci. Math. Nat. 1908, pp. 649–51.
See also *Ann. Mycol.*, vi. (1908) p. 199.

SACCARDO, P. A.—**Notæ Mycologicæ.**
[Descriptive notes on a large number of species, with diagnoses of new forms. *Ann. Mycol.*, vi. (1908) pp. 553–69 (1 pl.).

SYDOW, H.—**Myootheca germanica Fasc. xiv.–xv. (No. 651–750).**
[The diagnoses of five new species are included with the list of 100 species.]
Tom. cit., pp. 478–81.

SYDOW, H. & P.—**Novæ Fungorum species. V.**
[A number of new species and one new genus of Sphæropsideæ (*Readeriella*), distinguished by its plurilocular stromata and brown trigonous spores.] *Tom. cit.*, pp. 482–4.

" " **Micromycetes orientales a cl. J. Bornmüller communicati.**
[A list of species found on herbarium plants; a few that are new to science are described at length.]
Tom. cit., pp. 526–30.

THEISSEN, F.—**Fragmenta brasilica.**
[Notes and descriptions of a number of species, mostly micro-fungi.] *Tom. cit.*, pp. 531–5.

" " **Hypoxylon annulatum und sein Formenkreis.**
[The author arranges seven published species of *Hypoxylon* under three types. He is not quite sure that these three are distinct species.] *Tom. cit.*, pp. 536–8.

TORREND, C.—**Additions to the Fungi of the Counties of Dublin and Wicklow.**
[Fungi and Myxomycetes collected during a visit of three years duration.]
Irish Naturalist, xvii. (1908) pp. 25–7.

Lichens.

(By A. LORRAIN SMITH, F.L.S.)

Lichens from the High Altitudes of Savoy (La Tarentaise).*—J. Mahew has collected from many upland regions and now from the highlands of Savoy. He found a large number of foliaceous species in the forests, which extend up to 1800 m. The siliceous rocks gave another flora, also recorded. From 1898 m. high to 2188 m. the flora

* Bull. Soc. Bot. France, liv. (1907) pp. 232–40.

was very rich both in species and varieties, the foliaceous lichens becoming rarer and the crustaceous forms more frequent. Altogether from the heights of these mountains he gathered 112 species and 70 subspecies or varieties. On the Little Saint Bernard he found 70 species and 17 subspecies or varieties. Lichens, he found, were not susceptible to extreme cold, and a thick coating of snow due to an avalanche did not seem to change them. On the heights the colour was slightly fainter, but all were fertile and the apothecia normal and sporiferous ; the thallus was reduced, but not altered anatomically.

Tarbellien Lichens.*—Hue has thus named his list of lichens collected in the country to the west of the Landes and the Basses-Pyrénées. He gives an historical sketch of lichens as regards this district, and describes the district through which he himself worked, in the neighbourhood of Dax. He found much the same lichen flora there as further north on the English Channel, both regions being under the influence of the Gulf Stream. He lists 51 species, among others *Phæographis Lyellii*, a rare species first found in the New Forest. England, in 1808, and published by Smith in Sowerby's English Botany as *Opegrapha Lyellii.* He gives copious notes on many of the species, and adds an index.

American Lichens.†—G. K. Merrill has placed some badly defined forms of *Cladonia* under *C. multiformis*. It is nearly allied to *C. crispata* and *C. furcata* ; unlike the latter it bears cups, and it differs from *C. crispata* in having fissured podetia and usually closed cups. Merrill also describes *Alectoria tortuosa* sp. n., a pendulous greenish-yellow species from British Columbia.

T. C. Frye ‡ gives a list of lichens collected in the Mount Hood region, Oregon. He found *Evernia vulpina*—usually a sterile form—fruiting at high altitudes.

HEWITT, GORDON.—**A Contribution to a Flora of St. Kilda.**
[Includes a number of lichens collected by the author and determined by O. V. Darbishire.] *Ann. Scott. Nat. Hist.*, lxiv. (1907) pp. 240–1.

LESDAIN, M. BOULY DE.—**Notes Lichenologiques.**
[A series of notes on various lichens, some of them new, and on two fungi, *Rosellinia aspera* and *Torula lichenicola* f. *cerinæ* that were found growing on lichens.] *Bull. Soc. Bot. France*, lv. (1908) pp. 420–4.

,, ,, **Lichens des Environs de Versailles.**
[Lichens from the neighbourhood of Versailles. Supplement to a previous list. Some fungi are included.] *Op. cit.*, liv. (1907) pp. 680–98.

ZAHLBRUCKNER, A.—**Lichenes Philippinenses.**
[A list of Philippine lichens, including a description of one new species, *Stictis Elmeri*.] *Leaflets of Philippine Bot.*, ii. 21 (1908) pp. 435–8.

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* Bull. Soc. Bot. France, lv. (1908) pp. 1–19.
† Bryologist, xii. (1909) pp. 1–6. ‡ Tom. cit., p. 6.

Mycetozoa.

(By A. Lorrain Smith, F.L.S.)

North Dakota Slime-moulds.*—F. J. Seaver has made a collection of these in connection with the work of the North Dakota Agricultural College, and publishes a list of the species found in the neighbourhood, with descriptive notes. The species were identified and confirmed by T. H. Macbride, of Iowa.

Sorosphæra Veronicæ.†—This organism causes swellings on the stalks of various species of *Veronica*, and has been referred to the Ustilagineæ and also to the Phytomyxineæ. R. Maire and A. Tison have definitely settled its position in the latter group by the discovery of myxamœbæ in the cells of the host, which divide by successive mitoses and finally unite to form a multinucleate plasmodium. After a time the plasmodium breaks up into uninucleate naked cells, which divide, and the daughter-cells form the spores; each cell of the host containing a ball of spores. The authors consider the systematic position of *Sorosphæra* as very near that of *Plasmodiophora Brassicæ*.

Jaap, O.—**Myxomycetes exsiccati 2e série No. 21–26.**
[The Myxomycetes were nearly all found by Jaap in Prignitz, and contain fine examples of these organisms.]
Hamburg, 1908. See also *Bot. Centralbl.*, cx. (1909) p. 98.

Kusano, S.—**Photo-chemotaxis of the swarm-spores of Myxomycetes.**
[On the chemotactic effect of certain acids.]
Bot. Mag. Tokyo, xxi. No. 250 (1907) pp. 143–53.
See also *Bot. Centralbl.*, cviii. (1908) p. 615.

Schizophyta.

Schizomycetes.

Rate of Multiplication of Bacillus Coli.‡—M. A. Barber has studied the rate of multiplication of *Bacillus coli* at different temperatures—using a strain of the organism obtained from the Pasteur Institute, and employing a specially devised warm stage apparatus by which hanging drops containing single bacilli can be separated and observed. The medium used was beef-peptone broth.

In estimating the rate of reproduction of bacteria, if the number at the start is a, and the number at the end of the observation is b, and the number of generations n, then $2^n = \frac{b}{a}$, the validity of which assumes that each bacillus divides into two nearly equal parts, and that all the bacteria in a culture reproduce at nearly the same rate. The author starts with a single bacterium, so that $a = 1$, and the formula is simplified to $2^n = b$. If g be the time required to complete a full generation, and t is the time covered by the experiment, then $g = \frac{t}{n}$.

* Bull. Torrey Bot. Club, xxxv. (1908) pp. 577–80.
† Comptes Rendus, cxlvii. (1908) pp. 1410–12.
‡ Journ. Infectious Diseases, v. (Chicago, 1908) p. 379.

The author found that reproduction beginning at 10° C., increases rapidly to 37° C., where it reaches its maximum rate with a generation time of seventeen minutes; this rate is nearly constant up to 45° C., when it falls rapidly and reproduction ceases at 49° C. The values of *g* in the lower temperatures vary greatly, owing partly to the degeneration of the cells at these temperatures, and also to the difficulty of keeping constant low temperatures for the long time necessary to obtain a considerable number of generations. Degeneration and tendency to grow into threads, and the failure of some cells to grow, render the value of *g* above 45° C. unreliable.

Under constant conditions the rate of growth is constant as far as thirty-eight generations, and all offspring continue to divide at the same geometrical ratio as the parent bacilli. The author considers that it is not probable that any body temperature during fever can be high enough to alter the rate of reproduction of pathogenic bacteria.

With *B. coli* there is no correlation between motility and rapidity of division.

Myxococcus Javanensis.*—E. de Kruyff observed in course of a research on the cellulose-fermenting bacteria—using the method of Van Iterson—that after about three weeks there appeared on the paper plates a number of small round granules of a pale red colour. Microscopically these were seen to contain spores, two to three of which were usually joined together in chains; when brought in contact with a drop of water the spore-cases were dissolved and the spores escaped.

If these were transferred to agar containing NH_4PO_4 and $KHPO_4$, red colonies appeared after three days: temperature between 25° and 29° C. gave the quickest growth, but growth also occurred at 40° C.: the temperature had no effect on the production of red colour.

The colonies, which were composed of a mass of bacteria, had a slimy consistence, and moved over the surface of the agar plate like the plasmodia of mycetozoa. The bacteria were non-motile and usually curved, 6–7μ long by 0·6μ. They grew well on various neutral media; they stained with ordinary aniline dyes. They form round or elongated spore-cases, 70–100μ in diameter, of a pale red colour. The spores are round, 1·6μ diameter, and usually arranged in chains. In hanging-drop they were seen to grow in rods.

Pathogenic Sarcina.†—B. Galli Valerio has isolated a sarcina from the mucous secretion of the nose and pharynx of a man suffering from chronic pemphigus (pemphigus à répétition) of the mucous membrane of the nose and mouth. Films stained with carbol-fuchsin showed large numbers of sarcina bundles among the cells of the epithelium and pus. The organism stained by Gram's method; individual cocci had diameters of 1·5–2μ; they were always extracellular.

Agar plate cultures showed only colonies of this sarcina, though in those prepared from the pharynx there were a few colonies of *Micrococcus pyogenes*. Colonies on gelatin at 20° were similar to those on agar; the medium was not liquefied. Broth is uniformly clouded at

* Centralbl. Bakt., 2te Abt., xxi. (1908) p. 385.
† Op. cit., 1te Abt., xlvii. (1908) p. 177.

first, a white deposit being formed later, the medium becoming clear and of a slight alkaline reaction. There is good growth in milk without clotting, even after a month, but the medium becomes viscous and alkaline. The organism does not ferment glucose or lactose, and there is no production of indol. The sarcina is non-motile, and possesses no flagella, but the bundles are often seen joined together by filaments which readily stain by ordinary dyes, and probably arise from the viscous substance that surrounds the organism. A number of laboratory animals received inoculations, and the pathogenicity of the organism was established.

The author considers that this sarcina is nearly allied to *Sarcina* Loewenberg, and that it was the causative agent in the case of pemphigus.

Behaviour of Bacteria to the Surface of Flowing Water.*— M. Rothermundt finds that the number of organisms on the surface of flowing water varies inversely as the velocity of the stream; the number on the surface is greater than in the depth of the stream; this relation depending probably on the oxygen requirements of the bacteria. The number of bacteria on the surface, in contrast to that of those in the depth, undergoes great fluctuations within short time intervals, depending on the intensity of the light, the number being lowest at mid-day, and highest at night; this effect being due, not to the bactericidal action of light, but to a negative heliotropism—a bacterial photophobia.

Etiology of ("Schaumorgane") Foamy Organs.† — A. Ghon and M. Sachs have isolated an organism from a case of foamy organs which they describe as being distinct from previously described organisms causing this condition (viz. *B. ærogenes capsulatus*, *B. phlegmonis emphysematosæ*, *B. cadaveris butyricus*) although in many characters it resembles them. In anaerobic cultures made from the liver juice, the organism appeared as varying sized motile rods, either straight or slightly curved and possessing numerous peritrichous flagella. In cultures on glucose-agar, and also on other media, there appeared a few rods with pear-shaped, ball or arrowpoint-like swellings; screw-like forms occurred in some young cultures, and in old fluid cultures there were long slender unjointed threads. The organism stained with ordinary dyes, and it seemed that only young forms were stained by Gram's method. The rods formed spores situated more often at the middle than at the ends.

In an atmosphere of hydrogen good growth was obtained on glucose-agar, and abundant gas was produced in shake cultures. No growth occurred on aqueous agar with peptone and salt; there was good growth in gelatin, especially if glucose was added, the medium being liquefied. In broth there was a diffuse clouding and copious deposit; milk was slowly clotted, with abundant gas formation. Growth was obtained on solidified ascitic fluid, but the medium was never blackened or liquefied. The organism did not possess a high degree of pathogenicity for experimental animals. In a rabbit the foamy or sponge-like condition of the liver was obtained on inoculation of the organism.

* Centralbl. Bakt., 2te Abt., xxi. (1908) p. 523.
† Op. cit., 1te Abt. Orig., xlviii. (1908) p. 396.

Toleration of Bacteria for Alcohol and for Acetic Acid.*—C. S. Stokvis has observed the toleration of *Bacillus typhosus*, *B. coli*, *B. paratyphosus* (*B*), *B. prodigiosus*, and *Vibrio choleræ* for alcohol and for acetic acid. Emulsions of estimated numbers of bacteria were prepared from agar cultures of the organisms and treated with varying percentages of alcohol, and incubated at 37° C. for 24 hours; a loopful holding 1–8 mg. of the emulsions was then transferred to a second series of tubes containing 9 c.cm. of water or broth and again incubated for 24 hours, and the organisms in the resulting growth were enumerated.

The author found that marked diminution in the number of *B. coli* first occurred when the percentage of alcohol had reached 6 p.c.; that with *B. typhosus* this occurred first with 8 p.c. of alcohol, this organism being more resistant than *B. coli*; with *Vibrio choleræ* marked inhibition of growth occurred with 3 p.c. of alcohol; in the case of *B. prodigiosus* and *B. paratyphosus B* with between 4 and 6 p.c. of alcohol.

In similar manner bacterial emulsions are diluted with various percentages of acetic acid. The author found that in every tube the bacteria were collected in clumps at the bottom, and to obviate this effect the dilutions in broth were at once poured into tubes of gelatin and plated. Plates of agar were also prepared. Examination of plates after 24 hours showed a complete inhibition of growth with even $\frac{1}{4}$–$\frac{1}{2}$ p.c. of acetic acid. Employing the *Bacterium aceti* cultivated from beer, and grown on tubes of sloped agar, the author found that even after the addition of 7 p.c. of acetic acid there was still slight growth of this organism.

Bacterium polychromicum.†—H. Zickes finds that this organism grows well on various media; it exhibits great polymorphism, appearing as cocci on some media, on others as rods; it possesses no flagella, and does not form spores. It produces several chemically distinct colouring matters. The yellow substance (Lipoxanthin) occurs on dextrose-agar cultures at 20° C. The blue substance appears on potato; it dissolves when treated with an alcoholic solution of soda; an aqueous solution is decolorised by aluminium amalgam, but regains its colour if treated with a small quantity of peroxide of hydrogen; a watery extract of the potato culture mixed with a little glucose and peptone and inoculated with *Bacillus coli*, gradually loses its blue and assumes a yellow colour; the narrow layer under the surface, owing to the acid formation by the *B. coli*, takes a red-violet tint, which disappears on shaking, but returns after a short while.

Bacillus coli communis.‡—Agueda Terreira, A. Bettencourt, and others in four communications report that their researches confirm in great measure the results of the English bacteriologist as regards the general characters of *Bacillus coli* isolated from the human intestine. They add two points, viz., the power of fermenting lactose and the production of indol at the expense of peptone. With regard to

* Centralbl. Bakt., 1te Abt. Orig., xlviii. (1908) p. 436.
† Op. cit., 2te Abt., xxi. (1908) pp. 522.
‡ Arch. R. Instit. Bacteriol. Camara, Pestana, ii. (1908) pp. 155–270.

B. coli in mammals and birds, they agree with Savage and McConkey that at present there is no means of distinguishing these from the *B. coli* of human origin. Their researches as to the occurrence of *B. coli* in the lower Vertebrata and in cereals leads them to believe that their discovery in these hosts is more or less accidental. In the fourth paper the question whether the *coli* bacillus of man can be distinguished from those of animals by means of the fixation of the complement is definitely answered in the negative. The technique in all four papers is very full and useful.

Gum produced by Bacillus radicicola.*—R. E. Buchanan finds that when *Bacillus radicicola* is grown on suitable media, a considerable quantity of gum is produced. The organism was obtained from the root-nodules of forty-one species of legumes, and these were tested on saccharose-agar. The gum produced in saccharose solutions is closely related to the dextrans; it contains no combined nitrogen, does not dialyse readily, and appears to originate from the outer part of the cell-wall. The gum production is increased when certain substances are added to the saccharose, the optimum concentration of which is 2 p.c. Some of the favourable substances are salts of certain organic acids, glycerin (with or without ammonium phosphate), potassium nitrate, and peptone.

Intestinal Flora.†—E. Metchnikoff, in a study of the intestinal flora and its relation to intestinal putrefaction, discusses at some length the pathogenicity of *Bacillus putrificus*, *B. sporogenes*, and *B. welchii* (*B. capsulatus aerogenes*, vel *B. perfringens*). The inference drawn is that the intestinal canal contains a microbic flora, certain representatives of which are able to decompose albuminoid substance, and set free fœtid products, that is to say, are capable of exciting putrefaction. Owing to the presence of these putrefactive products which are absorbed by the mucosa of the intestine, the intestinal tube becomes a source of auto-intoxication.

Red Coccus resembling Micrococcus cinnabareus.‡—A. Clerc and A. Sartory isolated from the walls of the cavity in the thallus of the Alga *Codium Bursa*, obtained while dredging in the Mediterranean, a coccus which, from its general characters, resembled the *Micrococcus cinnabareus* Flügge. It was differentiated therefrom by its polymorphism, the non-viscosity of the cultures, the non-liquefaction of gelatin, and its relative liking for salt (chloridophilia), due possibly to its special environment.

Bacillus sporogenes non-liquefaciens.§—M. Jungano isolated from the large intestine of a *Roussette* a hitherto undescribed bacillus. It is long and thin, with rounded ends. It is easily stained, and is Gram-positive. It forms spores, and when it does so, becomes Gram-negative, a feature also noticed in fluid media, though the sporulation does not take place there. It is very mobile. The spore is terminal and ovoid.

* Centralbl. Bakt., 2te Abt., xxii. (1909) pp. 371–96.
† Ann. Inst. Pasteur, xxii. (1908) pp. 929–55.
‡ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 20–22.
§ Op. cit, lxv. (1909) pp. 716–18 (1 fig.).

It forms gas. In agar it forms round colonies and sporulates abundantly, but in saccharated media does not spore at all. It forms acid in saccharated media, coagulates milk, forms indol, and is not pathogenic to laboratory animals.

Properties of Bacillus tuberculosis cultivated on Bile.*—H. Calmette and C. Guérin found that when *Bacillus tuberculosis* of bovine origin is cultivated on bile it easily passes through the wall of the alimentary canal, and when it penetrates in large masses it may rapidly produce calcareous nodules. When injected intravenously into Bovines it produces a general febrile disorder without the formation of tubercles, a typho-bacillosis in fact. On bile medium human tubercle grows with difficulty, avian tubercle not at all, and per contra, each of these tuberculoses when cultivated on human or avian bile develops very rapidly.

HIBLER, VON EM.—**Untersuchungen über die pathogenen Anaeroben.**
[A treatise on about fifteen species of anaerobic bacteria; deals with the morphology, the biological characters, the methods of cultivation, the differential diagnosis, and the anatomical changes in the organs and tissues of the affected host.] Jena: G. Fischer, 1908, 415 pp. (17 pls.).

HAUSSER, A.—**Bakteriologische Untersuchungen über Geflügeldiphtherie.**
Centralbl. Bakt., 1te Abt. Orig., xlviii. (1909) pp. 535–83.

JUNGANO—**Sur la flore anaérobie du Rat.**
[Gives a short account of two bacilli, one filamentous, the other diphtheroid, both anaerobic and non-pathogenic.
Comptes Rendus, lxvi. (1909) pp. 112–14 (2 figs.).

* Comptes Rendus, cxlvii. (1908) pp. 1556–9.

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

Bausch and Lomb's Stand D D H.†—This Microscope (fig. 41) is the largest of the makers' series, and is intended for the highest class of work, its equipment being designed to make it well suited to research and all lines of precise investigation. The body-tube is made of suffi-

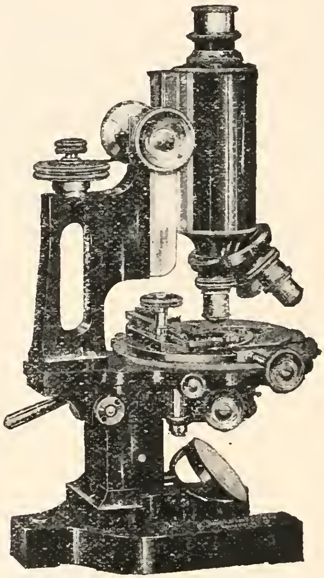


Fig. 41.

cient size to permit the use of a 72 mm. Micro-Tessar, with the full angle of view which that lens embraces. In the construction of the instrument the prime consideration has been the excellence and completeness of the finished product, and, while this policy adds to the cost, the resulting instrument is meant to be of a quality likely to be appreciated by those workers who require the best. The limb is fully inclinable, and the arm, large and very strong, is arranged so as to leave a distance of 75 mm. to the centre of the stage. The stage is circular, measuring

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Bausch and Lomb, Rochester, N.Y., Catalogue, Microscopes and Accessories.

112 mm. inside and 126 mm. outside the graduations, which are in single degrees. The stage is fitted with centring-screws, and may be removed when it is desired to substitute the plain stage. The mechanical stage may be revolved, and the movements for the slide-adjustment are very wide. Graduations are provided for recording the field. The sub-stage is complete in every particular. The lower iris-diaphragm may be revolved, and is actuated by a rack-and-pinion, so that any degree of oblique illumination may be obtained. The condenser stage swings out, leaving an iris-diaphragm in the main stage. The upper iris is removable at will, and the entire substage is focused by a rack-and-pinion. The body-tube is graduated, and is made of aluminium to

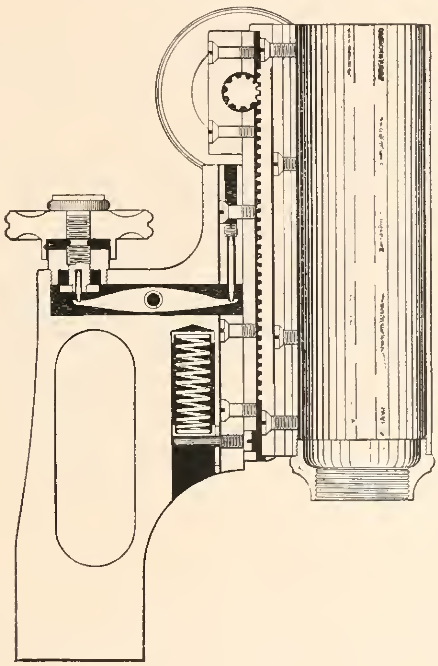


Fig. 42.

secure lighter weight; it is extra large for photomicrography. The lower collar is removable for attaching the Micro-Tessar objectives. The coarse-adjustment is by rack-and-pinion, and the fine-adjustment is by the new lever type. Each graduation on the micrometer screw-head, which is divided to give two speeds, equals 0·0025 mm. in vertical movement. The new lever fine-adjustment is shown in fig. 42. It is recommended as possessing no lateral motion, which in some types is observable after prolonged usage. The action is direct, and the response to the slightest turn of the micrometer-screw is immediate. The mechanism is entirely incased for the purpose of protection from dust.

The adjustment is controlled by the position of the fulcrum, and in the D D H the parts of the lever bear the relation of 2 to 1. The slide is very near the optical axis, the weight of the body-tube and optical parts only being moved, regardless of the length of the arm. This permits the use of larger stages without detriment to the fine-adjustment. With it, no force greater than the weight of the body-tube and its accessories is exerted on the cover-glass, for at the moment of contact the further movement of the screw has no action whatever upon the adjustment, and in this way damage is prevented.

Hensoldt's New Micrometer Microscopes.*—Fig. 43, numbered 48 in the makers' catalogue, illustrates an instrument intended for reading off meridian circles and geodetic instruments. The objective is achromatic, the flint lens being turned towards the graduation. The ocular is achromatic and orthoscopic. In order to give a maximum light-intensity the objectives are constructed of as diminished a focal length as possible; they thus require a weaker, and therefore less tiring, eye-piece. The micrometer-box is dust-proof, and the movement is destitute of dead-way. The measuring apparatus is double-threaded, and there are 5–10 teeth in the field of view, the drum being divided into 60, 100, or 120 parts. The illuminator is rotatory, to give maximum light, and the micrometer-screw has a movement of 0·25 to 0·3, or 0·5 mm.

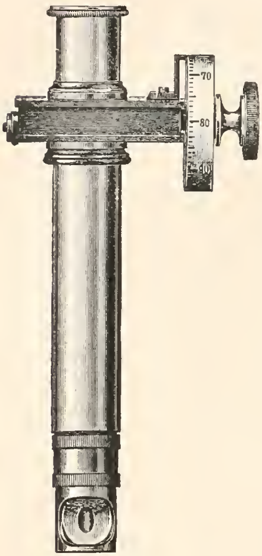


Fig. 43.

Application of Microscopes as a Means of Demonstration in Public Museums.†—G. Marktanner-Turneretscher, while fully cognisant of the difficulties arising from manipulation and expense which would attend the introduction of Microscopes into public museums, yet thinks that the interest which would be aroused by the observation of Microscopic objects deserves to be encouraged. He, therefore, discusses with considerable detail the principles which should underlie the construction of a museum Microscope. The instrument should be inclosed within a suitable glass case, in such a manner that the ocular protrudes. The object-stage should be rotatory and should carry at least twelve preparations: the rotatory apparatus should be controllable from the outside. The adjustment, as strong magnifications would never be required, should not be by micrometer-screw, but by sleeve-work with rack-and-pinion; he recommends a lever action in preference to milled-heads. There should

* Hensoldt and Sons, Wetzlar, Catalogue, Astronomische-Optik, pp. 7, 8.
† Museumskunde, v. pp. 39–42.

be a position-screw to prevent impact of the objective on the preparation. The author thinks, however, that there is much to be said in favour of a fixed tube and a movable object-stage, inasmuch as two tubes might then be fixed, for high and low powers respectively. Such tubes would be best placed at opposite ends of a diameter of the rotatory disk.

Bausch and Lomb's Pocket Dissecting Microscope Stand S.*—In designing this little instrument, fig. 44, compactness and convenience of carriage have been especially borne in mind. A stage attached firmly to the under side of the reversible cover holds the mirror set at the proper angle, together with a glass stage and a

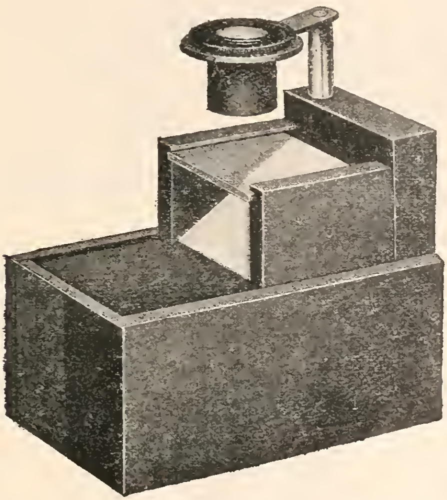


FIG. 44.

post for carrying the lens. A black and white metal plate is supplied with each instrument, and is to be placed over the mirror, according as a black or white background is desired. The lens is adjustable for focus on a metal post, and can also be used as a hand magnifier. The box is of mahogany, $45 \times 65 \times 102$ mm., and can be easily carried in the pocket. The post and lens are removable, and fit in the box. The cover slides in a groove; when right side up, it closes the box; when under side up, after insertion of the metal post in its opening, the dissecting Microscope is ready for use.

Bausch and Lomb's Compound Erecting Body.†—This instrument (fig. 45) is intended for use as a dissecting Microscope. By means of two double-reflecting prisms the image from the objective is inverted,

* Bausch and Lomb Optical Co., Rochester, N.Y., Catalogue, Microscopes and Accessories, p. 49.

† Tom. cit., p. 57.

so that when seen through the eyepiece an object is viewed as seen with the eye—not inverted and reversed, as with an ordinary Microscope. The body is mounted on a jointed arm to permit examination over large surfaces, and has a post to fit any of the firm's dissecting stands.

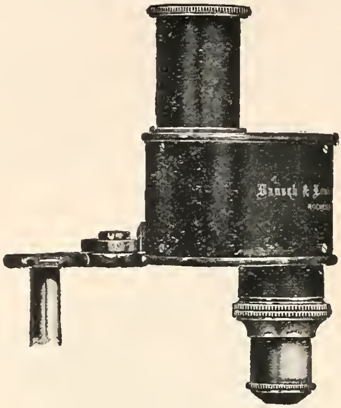


Fig. 45.

Koristka's Loup of Two Achromatic Lenses.*—In this instrument (fig. 46) the lenses are mounted in nickelled brass, and give a large flat field. The complete combination gives a magnification of ten

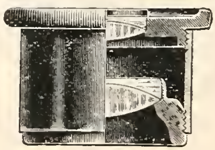


Fig. 46.

diameters, a field of 20 mm., and a frontal distance of 17 mm. By unscrewing the lower lens and operating only with the upper, a magnification of five diameters is attained, the field being 26 mm. and the frontal distance 27 mm.

Marx, H.—**Ein handliches Obduktionsmikroskop.**
Zeitschr. f. Medizinalb. Jahrg., xx. pp. 744–5.

Petri, R. T.—**A. van Leeuwenhoek's Mikroskop.**
Natur. Wochenschr., xxii. (1908) pp. 1–7.

Schertel, S.—**Der Bau des Mikroskops.** *Mikrokosmos*, i. (1907) hefte 1–2.

,, ,, **Uber frühere mikroskopische Forschungen und Bilder.**
Tom. cit., hefte 3–4.

Seibert, W. & H.—**Neues Stativ 5 C.**
Zeitschr. f. angew. Mikrosk., xiv. (1908) p. 85.

* F. Koristka, Milan, Catalogue xiii. (1908) Micrscopi ed Accessori, p. 77.

(2) Eye-pieces and Objectives.

Hensoldt's Micrometer-Oculars.*—These are manufactured with threaded insertions which can be cut to suit customers' instruments. Those described below are of a new type, and possess a notably increased field of view. The visible field is given by the angle under which the circumference of the field-diaphragm appears to the eye, and the real field of view is obtained by dividing the visible field by the telescope magnification. Fig. 47 is Hensoldt's orthoscopic micrometer-ocular. The visible field is about 42°, and the image is completely plane and achromatic. The optical combination consists of one double achro-

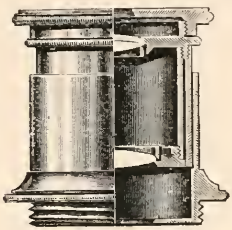


Fig. 47.

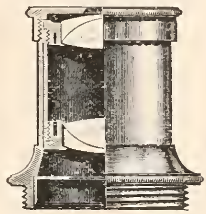


Fig. 48.

matic lens and a bi-convex lens. Fig. 48 is Hensoldt's euryscopic micrometer-ocular. Here the visible field is 45°, and the optical combination is two double achromatic lenses. The field is remarkably large, and absolutely colourless and plane. The image-point and eye-point are well separated.

(3) Illuminating and other Apparatus.

Koristka's Complete Apparatus for Macro- and Micro-projection.† The maker's catalogue shows the arrangements for (1) the macroscopic projection of diapositives on glass; (2) macroscopic projection of opaque objects; (3) microscopic projection of liquid preparations; (4) microscopic projection of solid preparations. The last of these is reproduced here (fig. 49). The light source is a Schuckert lamp with a very sensitive regulator for maintaining absolute constancy at the light focus. The first condenser, the iris diaphragm, the second condenser and trough are easily recognised in the diagram. They are all carried on suitable supports sliding on an optical bench, and have adjustments for keeping the incident beam in the optical axis. The light is then ready for transmission on to the solid object on the Microscope stage, and thence on to the objective. To facilitate the exhibition of numerous slides, the makers have designed a disk pierced with sixteen excentric apertures. The disk is fitted with suitable clips so that sixteen preparations may be affixed in situ, and, the disk being pivoted, these preparations may be brought as rapidly into the field of view as desired. A second disk is

* Hensoldt and Sons, Wetzlar, Catalogue, Astronomische-Optik, pp. 5, 6.
† F. Koristka, Milan, Catalogue xiii. (1908) Microscopi ed Accessori.

provided, so that an assistant may equip it with slides and exchange it for the first disk at the proper time. It is recommended that the ocular be removed, and projection effected by a projection-objective alone.

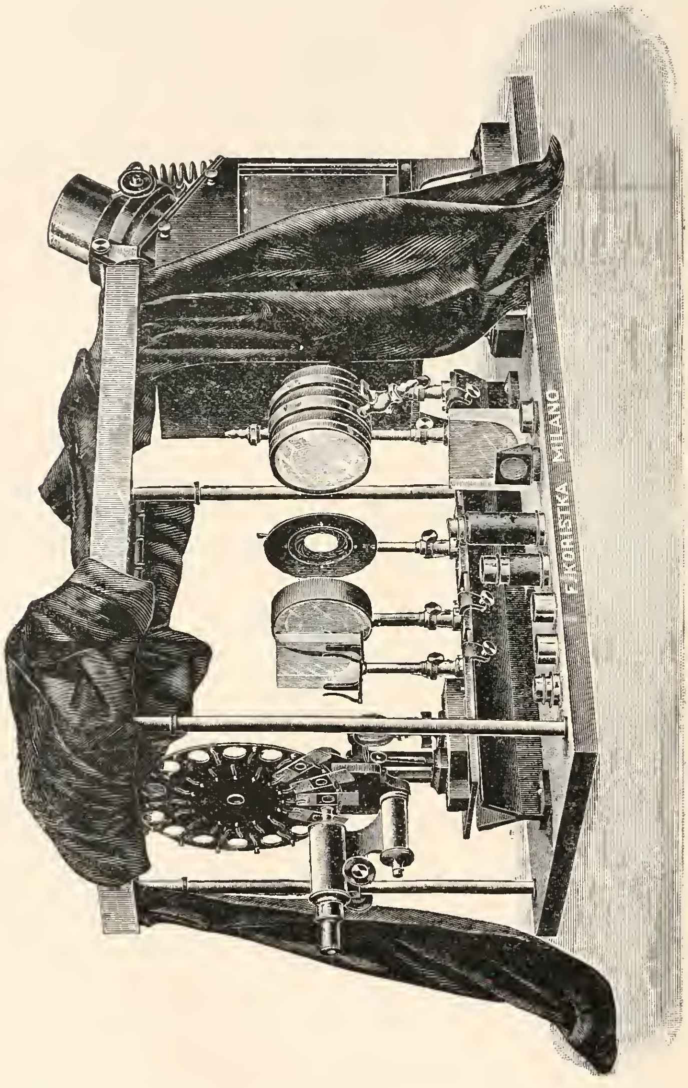


FIG. 49.

Koristka's Apparatus for Drawing with Weak Magnification.*— This apparatus, shown in fig. 50, consists of three distinct parts:

* F. Koristka, Milan, Catalogue xiii. (1908) Microscopi ed Accessori, p. 61.

the source of light in a metallic box fitted with a double condenser; a support for the separation and projection objective; and a reflecting-

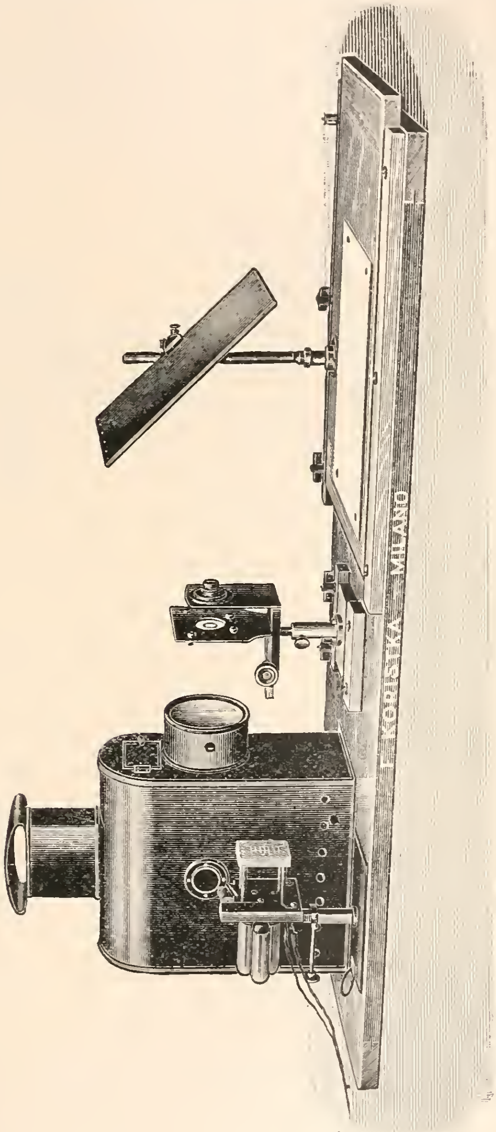
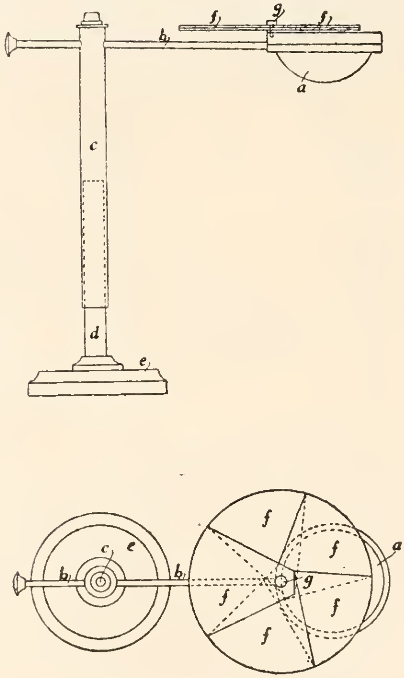


Fig. 50.

mirror fixed by a post to a sliding drawing board. The whole is mounted on a wooden base 1·3 by 0·5 m. The position of the mirror is variable, and a catch-spring marks the position of 45°. The projection and objective support slides between guides fixed to the base-board. The preparation-stage is adapted for the largest preparations, and the objective is focused by rack-and-pinion. The drawing-board is 40 × 50 cm. and the reflecting-mirror 20 × 28 cm. Microplanar projection objectives are recommended. The best source of light is a Nernst lamp with automatic regulation. The luminous intensity is about 700 candle-power with 110 volts; and 1400 candle-power with 220 volts. In the absence of electricity an incandescent gas-lamp is recommended.

Colour-disks for Microscope Condensers.* — R. Cleminson has invented a simple means of applying colour-disks to an ordinary con-



Figs. 51, 52.

denser so that the colours may be readily changed or varied. In the accompanying illustrations fig. 51 is a side elevation, and fig. 52 a plan view of a condenser of well known type provided with the colour-disks; *a* is the condenser itself secured to an arm *b*, carried by a tube or sleeve *c*, which latter is adjustably mounted upon a rod *d* supported by the base-plate *e*, while *f* represents strips of variously coloured

* English Mechanic, lxxxviii. (1908) p. 368 (2 figs.).

transparent celluloid, which are adapted to be moved in fan-wise fashion about a pivot-piece *g* screwed to the condenser rim. By moving one or more of these coloured strips over the condenser, the desired colour-effect upon the object may be attained.

Bausch and Lomb's Filar Micrometer.*—This micrometer (fig. 53) consists of a series of ruled lines 0·5 mm. apart, with every second graduation number up to ten in either direction from a long centre line. This scale is mounted with an eye-piece, and its position with reference to the edge of the image may be regulated by means of the milled head

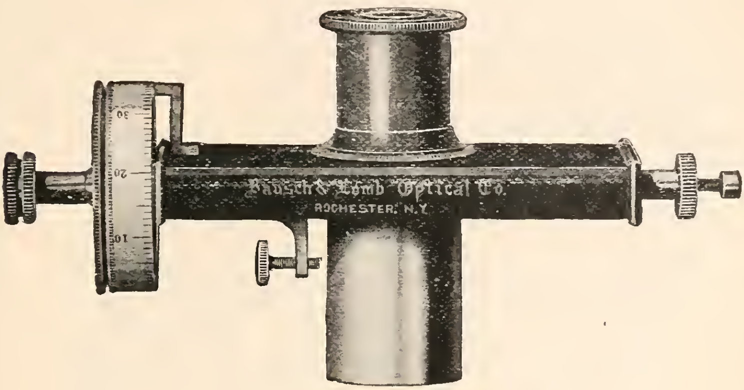


FIG. 53.

shown at the right in the illustration. A complete revolution of the micrometer-screw moves the cross-hair a distance of 0·5 mm. upon the scale.

Schmidt and Haensch's Special Episcope.†—This apparatus is intended for the projection of large illustrations, engravings, maps, etc., up to a magnitude of 40 × 40 cm.

As will be inferred from fig. 54, the apparatus essentially consists of a steel box containing an arc-lamp, a lens system, and a water-cooler. There is also an easily adjustable metal plate 65 × 65 cm.: also, two objectives in association with two plane front-silvered mirrors. A cloth curtain effectually screens any three sides, so that pictures, etc., may be introduced from any desired fourth side. The arrangement of the individual parts and the ray-path are shown in fig. 55. In order to attain an increased brightness of image two arc-lamps of 35 amperes are inserted, one behind the other. The second lamp and condenser are not visible in the figure, as they lie directly behind L_1 and K_1. This duplex arrangement is recommended as being more effective, and as requiring no greater consumption of current than in ordinary forms of such apparatus. To avoid unnecessary waste of light the rays after

* Bausch and Lomb Optical Co., Rochester, N.Y., Catalogue, Microscopes and Accessories, p. 61.

† Deutsche Mechaniker-Zeitg. (Nov. 1908) pp. 213–16 (2 figs.).

issuing from the water-cooler impinge upon the stage (40 × 40 cm.) and the object thereon. If it should be desired to make the illuminated area on the stage smaller and brighter, an additional condenser K_2 can

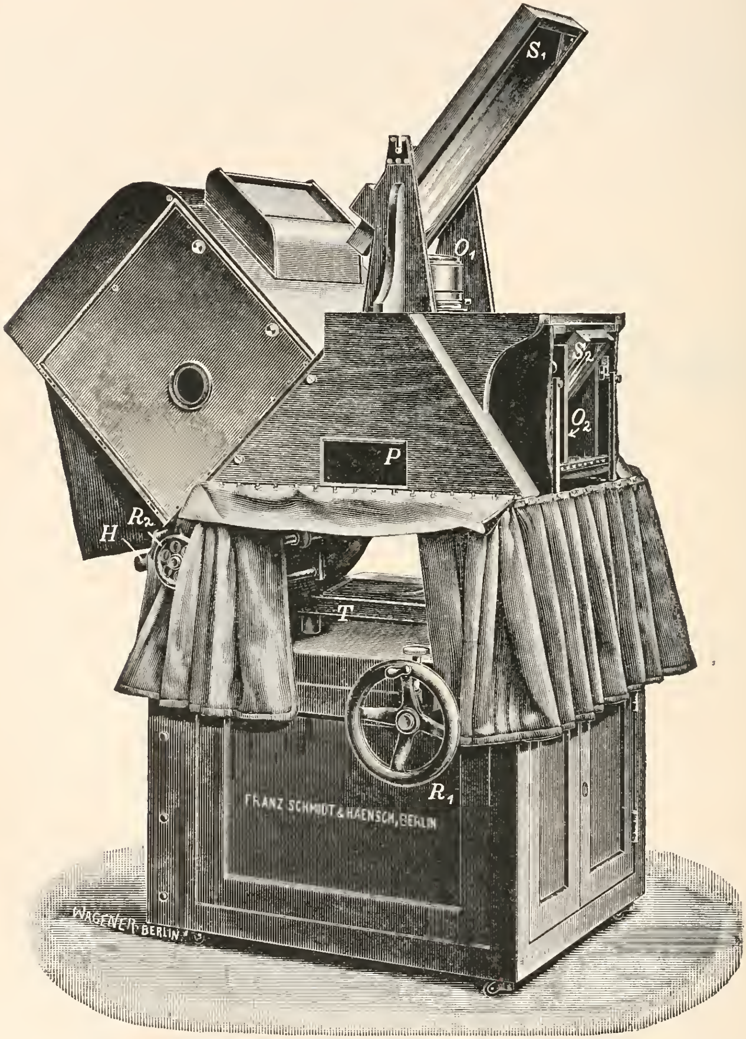


Fig. 54.

be pushed into the dotted position so as to parallelise the rays. Small adjustments of the two lamps are effected by the handwheel R_2. The rays reflected from the stage pass through the objective O_1, and, after impact on the front-silvered adjustable mirror S_1, are projected on to the screen. Sharpness of projection is attained by manipulation of the handwheel R_1 governing the objective. The magnification attained is 8 to 10-fold, and the images are 3·2–4·0 m. in diameter. A second objective of shorter focus is provided for the purpose of bringing out

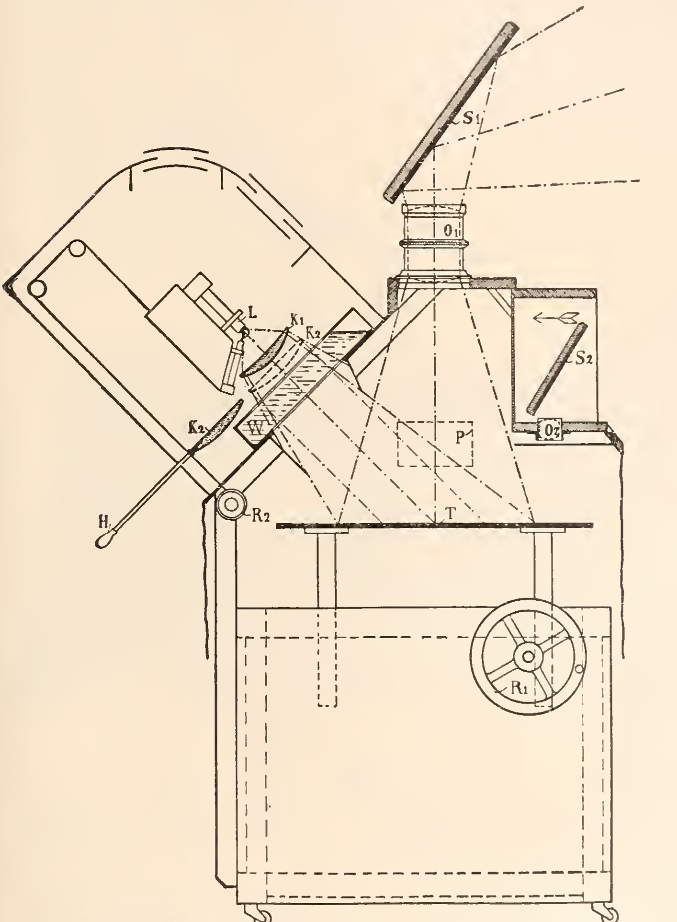


Fig. 55.

peculiarities of the larger pictures. This second objective O_2, fitted with a similar mirror S_2, is pushed into position in the direction of the arrow, and O_1 is thereby automatically put out of action. S_2 is so mounted that it forms its image in the same spot as S_1 does. P is a smoked-glass plate for convenient observation of the object on the stage. It has been thought best not to provide this apparatus with a contrivance for the projection of diapositives, as the convenience of the hand-movements would irretrievably suffer.

Diapositive projection, as well as the projection of physical experiments, is performed by Schmidt and Haensch's apparatus shown in fig. 56. A lever h_1 can insert a reflecting glass plate s_1, inclined at 45°, for receiving the light-rays coming from the source on the left.

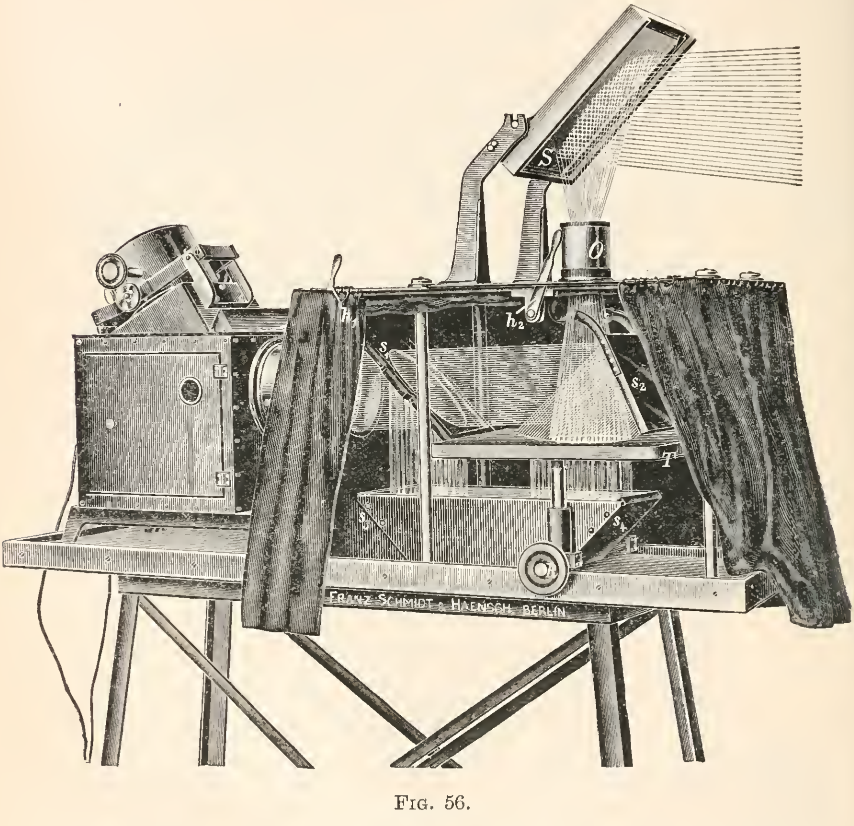


FIG. 56.

In consequence, most of this light is reflected downwards at s_1, and by means of mirrors s_3, s_4, impinges on the under side of the object placed on the stage at T. Some of the light, however, passes through s_1, and therefore illuminates the upper surface of the object at T. The effect is to bring out structural and inner details so that a much improved image, by help of the objective O and mirror S_1, is projected on the screen. If desired, a mirror may take the place of s_1, and the object would now be entirely illuminated from below. Or, again, the rays may fall directly on s_1, thus giving upper illumination only.

Krüsz's Epidiascope.*—This instrument is intended for the projection (1) of opaque objects in reflected light; (2) of transparent objects in transmitted light; (3) of physical investigations in the horizontal position with transmitted light; (4) of microscopic objects with the polarising Microscope; (5) of spectral, polarising, and interference phenomena with the optical bench. The light-source is an arc-lamp with a horizontal positive carbon and a vertical negative carbon. The lamp is adjustable on runners. The light-rays emanating from the crater B (fig. 57) are collected by the condenser K, and issue therefrom, according to the position of the lamp, as a parallel, slightly divergent, or convergent beam. The rays then pass through the

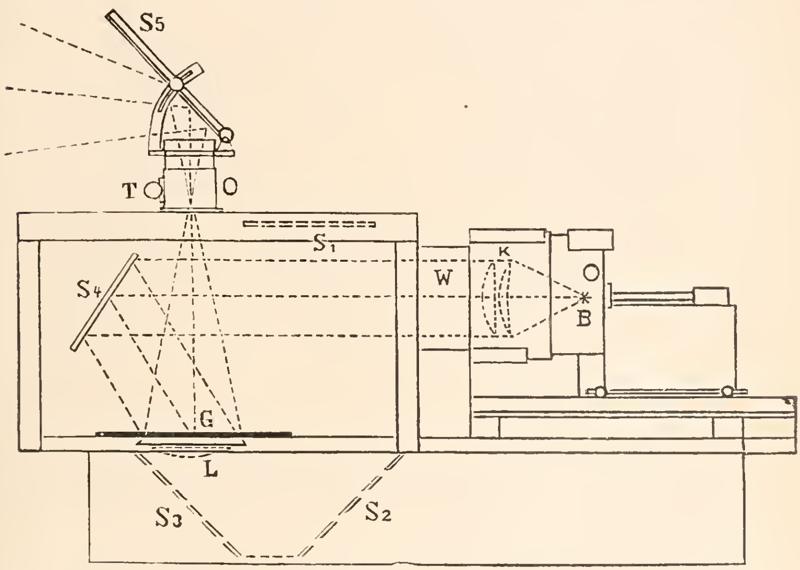


Fig. 57.

cooling-trough W. Two mirrors, S_1 and S_4, are placed under the upper plate of the apparatus. When the projection of opaque objects is required, as in fig. 57, the mirror S_1 is put out of action, and the rays, after impinging on S_4, are reflected on to the stage, which by means of an inserted board now form an unbroken plane. The illuminated object on the stage is focused through the objective O, on to the adjacent reversing-mirror S_5, and thereby projected on to the screen. The stage of the apparatus is large enough for the reception of drawings and pictures with a breadth of 60 cm. and with any desired length. When the apparatus is wanted for the projection of transparent objects, the mirror S_1 is brought down into the position shown in fig. 58, so as to receive the incident light, and the rays take the direction shown by the dotted lines. After reflexion at S_1 the rays pass through an aperture

* Deutsche Mechaniker-Zeitg. (Sept. 1908) pp. 166–8 (2 figs.).

in the stage-floor on to the mirror S_2, whence they pass on to the mirror S_3, and thence from the lens L on to the object D. The light, after transmission through the transparent object D, has the same course as for the projection of the opaque object. For physical de-

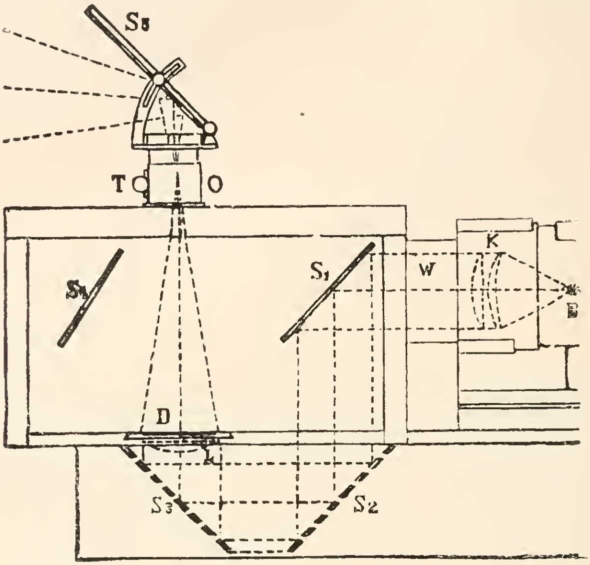


Fig. 58.

monstrations both the mirrors, S_1 S_4, are put out of action, the front wall of the apparatus is folded down, and direct projection is made on to the screen.

Evatt, Ev. J.—**The Cameragraph: a Drawing Apparatus.**
Journ. Anat. Physiol., ser. 3, iii. No. 42 (1908) pp. 335–6 (1 fig.).

Francé, R. H.—**Das Zeichnen mikroskopischen Objekte.**
Mikrokosmos, ii. (1908–9) hefte 1–2.

Heinstädt, O.—**Spiegelkondensor u. paraboloid.**
Zeitschr. wiss. Mikrosk., xxv. (1909) pp. 188–94.

Siedentopf, H.—**Spiegelkondensoren.**
[Polemical writings as to priority of invention of mirror condensers and paraboloids.] *Tom. cit.*, pp. 195–8.

Siede, W.—**Hilfsapparate des mikroskopischen Zeichnens.**
Mikrokosmos, ii. (1908–9) hefte 1–2.

(4) Photomicrography.

Contribution to the Theory of the Photographic Web.* — H. Calmers and L. P. Clerc, in discussing the above theory, deal with a

* Comptes Rendus, cxlvi. (1908) pp. 905–7 (2 figs.).

chequered web formed of two systems of parallel and opaque equidistant bands. whose width equals that of the transparent intervals, the bands intersecting at right angles and so forming square transparent meshes. If such a web is placed a short distance in front of a sensitive photographic plate inside a suitably constructed apparatus, the diaphragm in the objective projects behind the web cones of full light, and cones of pure shadow connected by a zone of varying penumbra. It is possible to determine the variations in the illumination of the sensitive plate when the diaphragm is subject to ordinary conditions, that is when the diaphragm presents a square aperture whose diagonals are parallel to the bands of the web, the dimensions being such that the plane of the sensitive plate contains the vertices of the cones. This will be the case when the ratio of the diagonal of the mesh to the distance between the web and the plate equals the ratio of the side of the diaphragm to the extension of the camera. In the absence of the web and after focusing, the diaphragm seen from any point of the web-plane appears to be a luminous surface of uniform brightness, the said brightness being proportional to that of the point conjugate to the object-point at which we supposed the eye placed. The light-beam illuminating each point π is limited by the pyramid having π for vertex and the contour of the diaphragm for base. Owing to the interposition of the web, there will be a reduction of the illumination at π if the opaque bands of the web which impinge on this pyramid, reduce the useful section of the beam by the plane of the web. This section can be taken as a measure of the illumination. The authors show that the curves of equal illumination (isophotic curves) take the forms of circles and of equilateral hyperbolas. They also show that a knowledge of these curves renders possible a previous determination of the web-image at a given part of the sensitive plate.

Advances in Photomicrography and Projection.*—In the Jahrbuch für Photographie und Reproduktionstechnik für das Jahr 1908, G. Marktanner-Turneretscher summarises, with his usual thoroughness, the most important contributions to photomicrography and projection, published in the scientific journals of different countries. The results are classified under the headings of : (*a*) Mikrophotographie ; (*b*) Projektion ; (*c*) Kinematographie.

JENCIC, A.—**Ein wichtiger Fortschritt der mikroskopischen Beleuchtungmethoden.** *Allgm. Zeitschr. f. Bierbr. u. Malzfabrikat.*, xxxvi. (1908) pp. 179–82. (6 figs.)

(5) Microscopical Optics and Manipulation.

Brownian Movements.†—J. Perrin, in commencing his article on the above subject, reminds his readers that every particle situated in a fluid in equilibrium, is in a condition of continuous and quite irregular agitation in proportion to its minuteness. Gouy has shown that this eternal agitation is an essential property of fluids, and has suggested a very attractive explanation, by supposing that it is a visible consequence of

* Edited by Dr. J. M. Eder. Halle : W. Knapp ; also separately as a pamphlet.
† Comptes Rendus, cxlvi. (1908) pp. 976–70.

molecular shocks acting irregularly against the particles. J. Perrin now describes experiments which he believes prove that molecular movement is indeed the real and only cause of Brownian motion. He obtained an emulsion of gamboge, and found it full of microscopic particles exhibiting active Brownian movement. By centrifuging this emulsion he obtained a finer emulsion, from which, although unchanged to outer appearance, the microscopic particles had disappeared, leaving ultra-microscopic spherical particles (or granules) in their place. He studied the distribution of these particles at various levels, and, as the result of averaging several thousands of readings, he found that if the concentration of particles at a certain level be represented by 100, it is represented at levels 25, 50, 75, and 100 microns lower by numbers closely approximating to 119, 142, 169, 201, which are in geometrical progression. This leads to the conclusion that the distribution of equilibrium of these particles in the gamboge emulsion, and probably in every other colloidal solution, resembles those of a gas in equilibrium under the influence of its own weight. But in this case reduction to half-density, which in the atmosphere requires an elevation of six kilometres, here requires one-tenth of a millimetre. By further experiments, involving minute measurements, he showed that the osmotic pressure exerted by these particles corresponds, within the limits of experimental errors, to the laws of gaseous pressure. Thus the spherical particles in suspension act as visible molecules of a perfect gas. The mean kinetic energy of a granule of a colloid is thus equal to that of a molecule.

E. E. Fournier d'Albe,* in summarising the present state of knowledge on this subject, remarks that if particles one-tenth of a micron in size could be observed, the conditions would be favourable for observing Brownian motions in gases themselves.

Aberration of Sloped Lenses, and their Adaptation to Telescopes of Unequal Magnifying Power in Perpendicular Directions.† — Lord Rayleigh, in treating the above subject, divides his paper into two parts, which are, to a large extent, independent. The first part deals with mathematical aspects of the question, while the second discusses the advantage which often attends a magnification unequal in different directions, and describes the methods available for obtaining it. Among these methods is that of the sloped object-lens. Such sloping introduces in general unsymmetrical aberration, and the intention of the first part is largely to show how this may be minimised so as to become unimportant.

It is a common experience in optical work to find the illumination deficient, when an otherwise desirable magnification is introduced. Sometimes there is no remedy except to augment the intensity of the original source of light, if this be possible. But in other cases the defect may largely depend upon the manner in which the magnification is effected. With the usual arrangements magnifying takes place equally in the two perpendicular directions, though perhaps it may be required in only one

* English Mechanic, No. 2285 (1909) p. 529.
† Proc. Roy. Soc., lxxxi. No. A 544 (July 1908) pp. 26–40.

direction. For example, in observations upon the spectrum, or upon interference bands, there is often no need to magnify much, or perhaps at all, in the direction parallel to the lines or bands. If, nevertheless, we magnify equally in both directions, there may be an unnecessary and often very serious loss of light. The author has found the use of a cylindrical lens (e.g., a glass rod, 4 mm. in diameter), give a very high magnification in one direction, and it appeared that the combination of such an eye-lens with a sloped object-lens constituted a very satisfactory solution of the problem. After the reading of the paper before the Royal Society, the author found that use of cylindrical lenses had been previously made by Rudolf, Lippich, and S. P. Thompson, though with differences in detail.

(6) Miscellaneous.

Quekett Microscopical Club.—The 454th Ordinary Meeting, which was also the 43rd Annual General Meeting, was held at 20, Hanover Square, W., on Friday, February 5, 1909, the Right Hon. Sir Ford North, F.R.S., Vice-President, in the chair. Mr. F. W. Watson Baker, F.R.M.S., for Messrs. W. Watson and Sons, Ltd., gave a demonstration on "The Making of a Microscope Objective." The chief exhibits were—Examples of optical, flint- and crown-glass, with pieces "slit" ready for working. An optical-worker's lathe, at which the preliminary stages in the production of a lens were carried out. At another bench the final figuring and polishing of a high-power "front" were shown, together with examples of "proof-plates," which take the place of the old-fashioned templates. The 43rd Annual Report of the Committee was read by the Hon. Sec., and the Hon. Treasurer presented his Report for the year 1908. The officers elected for the year 1909 are the same as for 1908. Dr. Duncan J. Read, M.B., C.M., gave a lecture on "A Method of Estimating the Exposure required in Photomicrography with Axial Cone Illumination." With a given class of subject and with known N.A. and magnification, the correct exposure is obtained experimentally. A table is constructed for this N.A., calculated for other magnifications in the usual method. When employing other N.A. it is necessary to measure this immediately before making the exposure, and to apply a correction from a second table. The N.A. may be obtained as follows: Measure the diameter of the Ramsden disk of the ocular. Multiply half this diameter by the magnifying power of the ocular, and divide by the focal length of the objective. This gives the required N.A.

The 455th Ordinary Meeting was held on March 5, Dr. E. J. Spitta, F.R.A.S., F.R.M.S., Vice-President, in the chair. A paper on "The Structure of the Eye Surface, and the Sexual Differences of the Eyes in Diptera," communicated by Mr. W. Wesché, F.R.M.S., was read by Mr. F. J. Perkes. Mr. T. B. Rosseter, F.R.M.S., gave an account of some recent work on the genus *Hymenolepis* (avian tapeworms), and described a new species, *Hymenolepis accicula-sinuata* sp. n., taken from *Anas boschas fera*. This will be fully described and figured in the next issue of the Journal of the Quekett Microscopical Club.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Media for Detection of Bacillus coli in Drinking-water.†—G. E. Gage finds that lactose-neutral-red broth is a good means of making presumptive tests for *Bacillus coli* in drinking-water, but the test must be limited ; the author's results are based on a reaction which calls for 25–30 p.c. gas formation with reduction of the neutral-red, three days being allowed for a complete reaction.

The bile-salt broth of MacConkey and Hill gives a reaction in a shorter time, but not so readily when only a few colon bacilli are present. Smith's solution of ordinary broth with 1 p.c. dextrose does not give such uniform results, and does not exclude organisms which have the power to ferment glucose. In using Endo's medium, forty-eight hours must be allowed for a complete reaction ; a pink or light red coloration is not sufficient ; if in forty-eight hours dark red colonies show up, *B. coli* may be assumed to be present. Lactose-litmus-agar is not very useful for plating the organisms, since it does not react readily to the smaller traces of acid produced by different strains of the colon bacillus.

Filtration of Agar through Glass-wool.‡—Th. Porodko finds that the velocity of filtration of agar solution through glass-wool is greater than through filter paper, and that the transparency of the solution is 80–90 p.c. greater : but for the thin layers generally used in plates and tubes this difference of transparency is not appreciable.

Simple Medium for Gonococcus.§—Piorkowski states that on a medium of the following composition, gonococcus grows well and keeps alive for 8 to 12 days, and further mentions that pneumococcus and meningococcus thrive therein :—To a litre of fresh milk are added 5 c.cm. of dilute hydrochloric acid (1 : 4), and incubated at 37° C. until all the casein has precipitated (16 to 20 hours). Or instead of this the milk may be boiled. The filtrate is neutralised with 10 p.c. soda solution and then boiled in a steam bath for a couple of hours, after which it is neutralised again and filtered. The medium is now distributed into flasks or test-tubes and sterilised at 100° C. for one hour. With this stock a fluid medium may be made by mixing with equal bulk of broth or a solid medium with agar (1 : 2).

Should any casein subsequently separate out from the stock, the supernatant clear fluid should be teemed off and mixed with broth or with agar liquefied at from 40–50° C.

Cultivating Amœbæ and Anguillulæ for Class Work.‖—A. Le Dantec obtains amœbæ by tearing up pieces of moss by the roots and

* This subdivision contains (1) Collecting Objects, including Culture Processes ; (2) Preparing Objects ; (3) Cutting, including Imbedding and Microtomes ; (4) Staining and Injecting ; (5) Mounting, including slides, preservative fluids, etc. ; (6) Miscellaneous.

† Centralbl. Bakt. 1te Abt. Orig., xlviii. (1908) p. 280.

‡ Op. cit., 2te Abt. Orig,, xxi. (1908) p. 424.

§ Münchener Med. Wochenschr., 1908, p. 735.

‖ C.R. Soc. Biol. Paris, lxvi. (1909) p. 237–8.

floats them on a beaker filled with water, and then incubates them at 35°. After 3 or 4 days a culture of amœbæ and bacteria is found on surface. After a few more days the amœbæ are found in the encysted stage. To obtain anguillulæ the droppings of guinea-pigs or a mixture of the droppings of guinea-pigs and rabbits are floated on the surface of water in a vessel so as to make a continuous layer. After an incubation at 35° of from 8 to 10 days, if the surface of the crust be scraped and examined under the Microscope, anguillulæ will be easily detected.

Differential Reaction for Bacillus coli communis and Bacillus typhosus.*—Lippens finds that *Bacillus coli* exerts a biochemical action on blood, and uses this to distinguish this bacterium from *B. typhosus*; 2 c.cm. of physiological salt solution are placed in two test tubes and then two drops of centrifuged and washed red corpuscles of the horse. To the one tube is added 1 c.cm. of a young broth culture (24 to 48 hours) of the typhoid bacillus, and to the other a culture of *B. coli*. The mixtures are shaken and placed in a rack. In 5 or 6 minutes the reaction begins to show itself at the bottom of the *coli* tube, where the mixture assumes a vinous violet hue. The reaction reaches its maximum in 10 to 15 minutes, after which it fades away. The typhoid tube remains unaltered. After having been placed in the rack the tubes must not be handled or shaken. The paratyphoid and paracoli bacilli give intermediate results.

(2) Preparing Objects.

Studying the Development of Cecidomyidæ.†—W. Kahle found that fixing the larvæ whole was useless. He therefore ripped up the mother-larvæ from head to tail with a needle; this was done under a dissecting Microscope, the insect being placed in salt solution. The eggs or embryos were then transferred by means of a capillary pipette to the following fixatives: either formol-alcohol-acetic acid (30 parts water, 15 parts 96 p.c. alcohol, 6 parts formol, and 1 part acetic acid), or Flemming's fluid. The former was allowed to act for 5 hours, the latter for 24 hours or more. The fixative is placed in a small tube, the mouth of which is covered with gauze. After fixation is ended, the fluid is removed by diffusion in upgraded alcohols. When dehydrated, the preparations are transferred to a glass cube, with a concave floor, by means of a camel-hair brush. In this is placed a mixture of alcohol and oil of cloves. Oil of cloves is added drop by drop until the fluid in the cube is approximately pure oil of cloves. The next step is to remove the objects to a mixture of equal parts of oil of cloves and collodion dissolved in ether, and thence to a glass plate, on which they are oriented under a binocular dissecting Microscope. They are next treated with xylol for 12 hours, and then, together with the glass plates, imbedded in paraffin; the plates are afterwards easily removed by immersion in water. The sections were stained with carmin, anilin dyes, and hæmatoxylin, of which Heidenhain's method proved the best. En masse staining was best done with acid-carmin; such preparations were either mounted in resinous or aqueous media.

The author, at the conclusion of his remarks on technique, mentions

* C.R. Soc. Biol. Paris, lxvi. (1909) pp. 95-6.
† Zoologica, xxi. (1908) No. 55, 80 pp. (6 pls. and 38 figs.).

that he eventually found in aceton a medium for fixing the larvæ without dissection, as in the foregoing procedure. After an immersion of 2 to 3 hours, the larvæ were transferred to 50 p.c. alcohol.

Preparing Disease-carrying Insects.*—A. E. Hamerton first strips off some pieces of the chitinous wall of the head, thorax, and abdomen and at once immerses the insect in the fixative, or dissects out the parts to be examined in the fixative. After an immersion of from 1 to 6 hours the material is transferred to 60 p.c. alcohol. A good fixative is picro-acetic acid (saturated solution of picric acid 100, acetic acid 1), which must be washed out with alcohol; it is more rapidly extracted with warm alcohol to which a little lithium carbonate has been added.

Other useful fixatives are :—1. Saturated solution of sublimate, with 2 p.c. glacial-acetic acid. 2. Absolute alcohol 1, glacial-acetic acid 1, chloroform 1 ; sublimate to saturation ; time, a few seconds to a few minutes. As soon as the objects become opaque, they are transferred to 70 p.c. alcohol. 3. Flemming's solution ; time, one to many hours or days ; the fixative must be thoroughly washed out in running water.

The next step is to dehydrate in upgraded alcohol, from 10 to 100 p.c. The object is then imbedded ; into a test-tube is poured sufficient cedar-wood oil to cover the object, and on the top of the oil a thin layer of absolute alcohol. The dehydrated tissue is then placed on the layer of alcohol, and when it has sunk to the bottom of the tube it is left for ½ hour or so in paraffin of low-melting point, say 50° C. A second paraffin bath is advisable ; time of saturating, 1 to 3 hours. When quite soaked with paraffin, a block is made as follows. Place a thin layer of glycerin in a Petri dish and heat slightly over a spirit lamp ; then pour over the glycerin a thin layer of the melted paraffin : and when this is beginning to solidify, pour in the rest of the paraffin, together with the pieces of tissue, and arrange them with a hot needle. Immerse the Petri dish in cold water, and then the paraffin cake will float off. Blocks are then cut out and trimmed for the microtome.

When dealing with chitinous structures, the material, after washing out the fixative, should be boiled gently for about 1 hour in 10 p.c. KHO.

For studying the mouth-parts of biting insects, the following procedure for keeping the component parts in their natural position is given. Take four small test-tubes. In tube i. make a saturated solution of gum-acacia in ether. In tube ii. make a thick syrupy solution of celloidin in ether. Mix the contents of these two tubes in equal quantities in tube iii. When proceeding to cut sections, take another tube, iv., and put into it 2 c.cm. of ether and a few drops of absolute alcohol. Then with a camel-hair brush moistened in water take a drop or two from tube iii. and mix it well with contents of tube iv. With this mixture paint the surface of the paraffin block after cutting each section. When fixed to the slide these sections must be treated with ether to remove the celloidin.

The sections are stuck on the slides by Mayer's albumen method, stained with Grenacher's alcoholic-borax-carmin, Delafield's hæmatoxylin, or Heidenhain's iron-alum-hæmatoxylin, and mounted in balsam.

* Journ. Roy. Army Med. Corps., xi. (1908) pp. 243–9.

Studying Spermatogenesis in Acrididæ and Locustidæ.*—H. S. Davis dissected out the testes in 0·6 p.c. salt solution, and placed them at once in the fixative. Many fixatives were tried, but only one, viz. Hermann's platino-aceto-osmic was much used, though in a few cases Flemming's fluid was adopted. After immersion in the fixative for from 1 to 2 hours, the testes were passed through alcohol and imbedded in paraffin. The best staining results were obtained from iron-hæmatoxylin, preceded by Bordeaux R. The sections were immersed in 1 p.c. Bordeaux R for 24 hours, then in the iron-alum for 1 or 2 hours, then in the hæmatoxylin for from 4 to 6 hours. It was necessary to dehydrate very rapidly, as Bordeaux R is very solvent in alcohol.

Studying Fat-absorption in the Intestine.†—G. E. Wilson fed guinea-pigs on egg-yolk diluted with tap water, or with olive oil. At suitable intervals the animals were killed, and pieces removed from the duodenum. The pieces were placed in the following fluid: 0·1 p.c. chromic acid 15 parts; 2 p.c. osmic acid 4 parts; glacial acetic acid 1 part, for about 12 hours. On removal the pieces were washed in running water for half an hour, and then in upgraded alcohols from 50 p.c. to absolute, this hardening and dehydrating stage taking about 132 hours. The pieces were imbedded in paraffin or in celloidin. The sections were stained with iron-alum, hæmatoxylin, and eosin, or with scarlet (scharlach R). The scarlet should be dissolved in 70–80 p.c. alcohol, shaken up from time to time and filtered. It should then be tested on a slide with olive oil, when, if good, a deep red reaction ensues in about a minute. For this dye the intestine may be fixed in formalin, and frozen sections used. The scarlet solution is allowed to act for about 45 seconds, and then, after a few seconds in tap water, the section is mounted in glycerin.

Studying the Chorda-cartilage of Urodela.‡—F. Krauss fixed the material in picro-sublimate-acetic-acid and in Carnoy's fluid, and stained the paraffin sections with kresyl-violet RR. This dye, which is a metachromatising pigment, stains cartilage and also mucin a rose colour, while the nuclei are blue. It was found better, however, to stain the nuclei with hæmalum. Care must be taken to dehydrate rapidly, as alcohol extracts the kresyl-violet rapidly. Methylen-blue and Bismarck-brown were also used. To the methylen-blue a little hydrochloric acid was added, and the stain fixed with molybdanate of ammonia. A triple combination of borax-carmin, Bismarck-brown, and light-green, gave effective pictures.

Demonstrating Hepatic Glycogen.§—N. Fiessinger fixes pieces of liver for 24 or 48 hours in 95 p.c. alcohol, and then immerses them in 10 p.c. tannin for half an hour to one hour, according to their thickness. They are then removed to 2 p.c. bichromate of potash for about 10 minutes. The pieces may then be washed, imbedded, and sectioned without risk of dissolving out the glycogen. The sections are stained with anilin oil-safranin, differentiated in alcohol, and mounted in balsam.

* Bull. Mus. Comp. Zool. Harvard, liii. (1908) pp. 59–158.
† Trans. Canadian Inst., viii. (1906) pp. 241–58 (2 pls.).
‡ Arch. Mikr. Anat. u. Entwickl., lxxiii. (1908) pp. 69–116 (3 pls.).
§ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 182–4.

The glycogen stains bright red, the nucleus pink and the cytoplasmic framework pale yellow. Two disadvantages of the procedure are mentioned, viz., the induration of the pieces and the superficiality of the tanning. The tanning even of thin pieces is often limited to the outer layers. In cutting the sections this must be borne in mind.

Carbon-dioxide for Killing Marine Animals.*—A. G. Mayer fills a siphon-bottle with sea-water and charges this with carbonic-acid gas by means of the "sparklet-bulb." The charged sea-water is then poured into a vessel containing sea-water in which the marine animals are living, and in a few moments they are completely narcotised and may then be killed in a fully expanded state by the addition of some fixative. In the case of Siphonophoræ the CO_2 should be followed by the addition of a small quantity of chloretone to prevent the swimming-bells from being cast off.

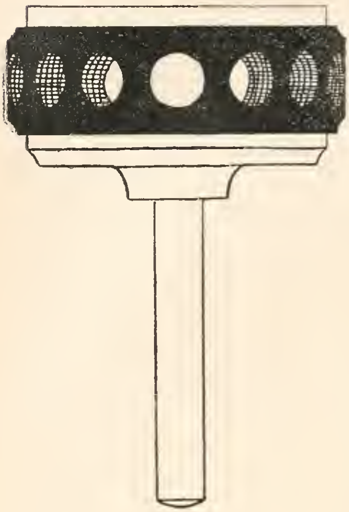


FIG. 59.

(3) Cutting, including Imbedding and Microtomes.

New Freezing-stage for the Zimmermann Microtome.† — M. Wolff, having been disappointed by the results of freezing with liquid carbonic acid, tried a spray of ethyl-chloride, and was surprised beyond expectation with the result. He experimented with a block 3 mm. high of *Angioma* freshly fixed in 10 p.c. formol with a section-plane of 2 cm. square. The freezing proceeded successfully in spite of the high temperature (19° C.) of the room. He applied the block to a Zimmermann microtome, and in one minute had cut so many sections (thickness 9 to 12 μ) that only 1 mm. of the block-height remained. The value of the ethyl-chloride expended was only 15 pfennige. This result encouraged the author to design a freezing-chamber specially adapted for ethyl-chloride, and his design (fig. 59) was executed by the firm of E. Zimmermann, Leipsic. His freezing-plate is, in contrast to the plates of the paraffin-stage, provided with concentric grooves. It has somewhat of the shape of a pill-box lid; its underside faces the interior of the apparatus, and is bored out cylindrically. The underside is covered with a coarse fibrous material for receiving the ethyl-chloride which would otherwise drop off. This freezing-plate is now screwed on a vulcanite ring connected with the usual stage carrying the footpiece clamped into the object-holder. The vulcanite ring is pierced with fifteen sufficiently large perforations through which the chloride spray can, in every position of the chamber, be directed on to the

* Biol. Bull., xvi. (1908) No. 1, December.
† Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 169–84 (4 figs.).

underside of the freezing-plate. The objects, fixed in 10 p.c. formol, are left in running water for two hours to wash out the fixing medium, and then, rinsed with distilled water, are applied to the freezing-plate. Even with a room-temperature of 21° C. blocks of 3 × 10 × 20 mm. will then remain frozen for five minutes. The after-freezing from the chloride-saturated fibrous layer supplies an additional and very welcome protection from the heat produced in working the microtome. Four grammes only of ethyl-chloride were found sufficient to produce the regelation described, and sometimes under favourable circumstances smaller quantities answered the purpose.

(4) Staining and Injecting.

Staining Spirochæta pallida in Smears with Largine.* — P. Ravaut and A. Ponselle describe their method of staining *Spirochæta pallida* by means of albuminate of silver. It is well known that the *Spirochæta* is stainable in sections by the silver method, whilst its demonstration in films is attended with difficulty. The authors have tried various trade preparations of albuminate of silver, but have obtained successful results only with Largine (Lilienfeld). They fix the smear with osmic acid vapour, with a mixture of osmic acid and bichromate, or chromic acid, and also merely with methylic-alcohol. The Largine solution consists of 2–100 grm. of distilled water. It should be fresh and kept in yellow bottles.

The fixed films are immersed in the Largine solution and incubated at 55° for two hours. Borrel's bottle is used, as it prevents evaporation. The slide is then transferred directly to a bath of 5 p.c. pyrogallic acid for a few minutes: it is advisable to pass the slide into a second bath for cleansing. The slide is then washed in distilled water, after which comes a second bath in Largine for half an hour, and this is followed by pyrogallic acid. It may then be examined. One of the features of this method is that all the microbes are stained. The authors admit that the films lose colour in a few weeks.

Fat-granules of Bacteria.†—P. Eisenberg describes very fully his experiments on *Bacillus anthracis* and *B. tumescens* with numerous pigments in order to demonstrate the presence of fat-granules. The paper is illustrated by two coloured plates, showing the effect of these dyes on the bacteria. The specimens were drawn under a magnification of 3000 diameters. In the bibliography there is no mention of Shattock's demonstration of fat in *B. mallei* quite ten years ago.

Demonstrating Bacillus tuberculosis in Cerebrospinal Fluid.‡ Manicatide draws off 20–80 c.cm., or even more, of the fluid by lumbar-puncture into sterilised test tubes, which are left for 6 to 24 hours. The delicate clot which always forms is then fished out with a platinum needle, spread out on a slide, and carefully teased out. The film is then fixed and stained in the usual way. The examination of the slide may be tedious and lengthy, but the results claimed by the author for his method are very satisfactory and definite.

* C.R. Soc. Biol. Paris, lxv. (1908) pp. 438–40.
† Centralbl. Bakt., 1te Abt. Orig., xlviii. (1908) pp. 257–74 (2 pls.).
‡ C.R. Soc. Biol. Paris, lxv. (1908) pp. 523–5.

Demonstrating Chondriosomes.*—F. Meves, when examining for the chondriosomes in the cells of fowl-embryos from the second half of the first to the beginning of the fourth day of incubation, fixed the material on the following modification of Flemming's fluid :—$\frac{1}{2}$ p.c. chromic acid with addition of 1 p.c. common salt, 15 c.cm. ; 2 p.c. osmic acid, 3–4 c.cm. ; acetic acid 3–4 drops. The sections were stained with iron-hæmatoxylin, and also by Benda's crystal-violet method. Successful staining by the latter method was attained with objects fixed in Flemming, even though the preparatory treatment advised by Benda (pyroligneous acid, 1 p.c. chromic acid, and 2 p.c. potassium-bichromate), were omitted.

Staining Treponema pallidum.†—T. G. Perrin allows a drop of blood to dry on a slide. This done, the film is treated with acetic acid-alcohol (absolute alcohol, 10 c.cm. ; acetic acid, 10 drops). This fixes the treponemes and leucocytes and dissolves out the hæmoglobin. The film is then stained by Giemsa's or other method. For staining the parasite in tissues, the material is fixed by immersion for 24 hours in the following fluid : formol, 10 c.cm. ; water, 100 c.cm. ; ammonia, 5 drops. After, the pieces are washed in water for several hours and then transferred to 15 p.c. silver-nitrate and incubated at 35° for six days. The blocks are now washed in distilled water and then immersed for 24 hours in the following reducer :—pyrogallic acid or hydroquinone, 1·5 grm. ; formol, 8 c.cm. ; water, 100 c.cm. On removal, they are washed in distilled water and then hardened in upgraded alcohols before imbedding in paraffin.

The author also gives a useful recapitulation of numerous other methods for staining spirochætes.

New Method of Nerve-cell Staining.‡—E. and Therese Savini use borax-methylen-blue prepared in the following way. A flask holding 200–250 c.cm. and made of glass which will stand sudden cooling with water, with a well fitting cork or stopper is used. Into this are poured 1 grm. medically pure methylen-blue, 4 grm. borax crystals, and 100 c.cm. of distilled water. The flask, without the stopper, is then placed in a water bath and boiled for half an hour. It is then removed, the stopper inserted, and cooled down with a stream of water, being shaken vigorously the while and the stopper removed occasionally. The flask is then re-boiled and removed several times for a further 30 to 40 minutes. The fluid is filtered before use. The method of use is essentially the same as that of Nissl, but celloidin sections are preferred. The stock solution is diluted one-half. The stained sections are differentiated in anilin-alcohol, cleared up in Cajuput-oil, washed in benzene, and mounted in benzene-colophonium. When mixed with 1 per thousand eosin solution in the proportion of 4 eosin to 1 borax-blue, it may be used like Romanowsky, etc., for blood and bacteria. In such case the stained films are rapidly washed in 2–4 per thousand acetic acid and then in absolute alcohol.

* Arch. Mikr. Anat. u. Entwickl. lxxii. (1908) pp. 832–3.
† Bol. Inst. Alfonso XIII., iv. (1908) 103 pp.
‡ Centralbl. Bakt., 1te Abt. Orig., xlviii. (1909) pp. 697–701.

Minute Structure of Bacteria.*—A. Amato employs the following method for studying the minute structure of bacteria. A thin layer of alcoholic solution of "brillant kresylblau" is spread on an object-slide, the alcohol is allowed to evaporate, and a drop of broth-culture of the organism to be examined is placed on the slide. If a solid culture be used, a loopful should be mixed with a drop of broth. In this way physical and chemical actions of fixation processes are avoided, and the form of the bacterial cells is almost unchanged.

The author gives drawings of the appearances observed in the potato bacillus, *Bacillus subtilis*, *B. mycoides*, and *Spirillum volutans*, of nuclear-like bodies and granules which he regards as nuclear equivalents.

Metallography, etc.

Colour-photography in Metallography.†—L. Révillon and P. Beauverie have used autochrome plates with much success. The yellow screen supplied by Lumière was quite unsuitable for use with the Nernst lamp, the light from which was found, indeed, to contain an excess of red rays. When a green screen (a solution of picric acid and methylen-blue) was used, the colours obtained on the plate corresponded with those observed by eye. Four reproductions of colour-photomicrographs are given, one of a 20 p.c. nickel steel, cemented, the other three of bronzes and brasses, which were etched by immersion in a boiling 50 p.c. solution of caustic soda, to which had been added a few drops of oxygenated water. This etching reagent is recommended for general use with alloys of copper.

Resilience, and Testing by Impact.‡—Resilience has been defined as resistance to shock expressed in kilogrammetres per square centimetre of original cross-section. L. Revillon has investigated the effect upon this "specific impact work" § of variation in dimensions of test-piece and in distance between supports. A Guillery machine was used. The energy absorbed is greater the less the distance between supports. If, however, all the dimensions of test-piece and also the distance between supports are altered in the same proportion, energy absorbed per unit area is then the same. The results of shock tests should always include an exact statement of the conditions of the test.

Shock-tests at Different Temperatures.‖—L. Guillet and L. Révillon have determined the work absorbed in rupture, in the Guillery machine, of eight different steels, at temperatures ranging from 20°–650° C. Resistance to shock increases up to about 200° C., then falls to a minimum at 475° C., again increasing at higher temperatures. There is no relation between resilience and the transformation temperatures. The results do not indicate that steel is brittle at a "blue heat" (300°–325° C.).

Temper-colours.¶—L. Guillet and A. Portevin find that the oxidation tints produced on a bright steel surface depend not only on the

* Centralb. Bakt., 1te Abt. Orig., xlvii. (1908) p. 385.
† Rev. Métallurgie, v. (1908) pp. 885–6 (4 figs.).
‡ Tom cit., pp. 887–92.
§ See this Journal, 1908, p. 261.
‖ Rev. Métallurgie, vi. (1909) pp. 94–101 (2 figs.).
¶ Tom. cit., pp. 102–4.

temperature reached, but also on the time for which the temperature is maintained. As, however, the tempering effect on hardened steel also increases with time of heating as well as with temperature, the correctness of the practice of judging the degree of "letting down" by the colour is confirmed.

Hardness of Steels at Low Temperatures.*—F. Robin has made Brinell hardness measurements on a large number of steels, at $-20°$, $-80°$, and $-185°$ C. He finds that hardness increases as temperature diminishes, the rate of increase being greater at the lower temperatures. Steels cooled to $-185°$ C., and allowed to return to the ordinary temperature, showed a slight permanent increase in hardness. Microscopic observations were made on austenitic steels cooled to low temperatures, and, together with low-temperature hardness measurements, confirmed the occurrence of a transformation in the austenite.

Hardness of Steels at High Temperatures.†—F. Robin has made a large number of careful hardness measurements, by the Brinell method, on steels at temperatures 10°–900° C. At the highest temperatures the impression was made by impact, while static loading was employed throughout the greater part of the range. The results are embodied in numerous curves. In general, for carbon steels, the hardness fell off with increasing temperature, up to 100°–150° C. It then increased, reaching a maximum at about 250° C., then diminished, more rapidly as the temperature rose. At 850° C. the difference in hardness of steels of different carbon content was small. The form of the temperature-hardness curves of the high-speed steels differed considerably from that of the carbon steels, these special steels retaining a much greater proportion of their original hardness at temperatures up to 600° C.

Silicon-silver Alloys.‡—G. Arrivaut finds that no compounds are formed in the silicon-silver system. Silicon is not held in solid solution by silver, but at the other end of the diagram there is a series of solid solutions of silver in silicon, having a maximum concentration of 10 p.c. The eutectic contains 5 p.c. silicon, and melts at 820°–830° C. The equilibrium diagram was obtained by thermal methods and confirmed by microscopic examination.

Micrography of Cement.§—E. Stern has microscopically examined cements at different stages of the hardening process, by reflected light. Polished and etched sections show two constituents, A, alite, present in greater amount than B, which, in hardening slowly, increases at the expense of A. The etching reagents found to yield good results were alkalis, alcoholic hydrochloric acid, alcoholic iodine solution, and 25 p.c. hydrofluoric acid.

Microscopic Study of Mortar.‖—G. Gallo has ascertained by microscopic examination of mortar that the calcium carbonate formed is distinctly crystalline; it is concluded that the lime and carbon dioxide

* Rev. Métallurgie, vi. (1909) pp. 162–79 (25 figs.).
† Op. cit., v. (1908) pp. 893–908; and vi. (1909) pp. 180–4 (19 figs.).
‡ Tom cit, pp. 932–4 (1 fig.).
§ Stahl und Eisen, xxviii. (1908) pp. 1542–6 (12 figs.).
‖ Journ. Chem. Soc., xciv. (1908) pp. 843–4 (from Gazetta Chimica Italiana, xxxviii. (1908) pp. 142–204).

must be in solution before the reaction takes place. The necessity for the presence of water is thus explained. The author deals fully with the reactions occurring during the setting of pozzuolana.

Different Phases of Matter.*—C. E. Guillaume gives an account of the experiments of Tammann, Spring, and others, on the behaviour of metals and other solids when submitted to great pressure. In general, wire-drawn metals are less dense than normal samples. Probably all solids under heavy pressures tend to be converted into an amorphous state, which has no discontinuity with the liquid and gaseous phases.

Study of Breakages.†—W. Rosenhain discusses the causes of breakages, and insists on the importance of investigating all cases of failure. Segregation, overheating, cold working are dealt with, and details of several instances of failure of steel are given.

Microstructure and Mechanical Properties of Steel.‡—The term "tenside" is adopted by A. Jude to express the roughness of the surface of a tensile test piece after breaking. The degree of roughness is a reliable index of the coarseness of the structure. Photomicrographs are given, supporting the author's view that, on the whole, there is a decided concurrence of the "tenside," the impact results, and the size of grain.

Experimental Study of the Thomas Process.§—In the course of a detailed study of the basic Bessemer process, F. Wüst and L. Laval have investigated the metallography of the iron-carbon-phosphorus alloys (containing also silicon, manganese, and sulphur), formed at different stages. The original iron contained cementite, mixed crystals, and a ternary mixed crystals-cementite-phosphide eutectic. As the carbon was eliminated, this ternary eutectic was replaced by a binary mixed crystals-phosphide eutectic. Many photomicrographs, two of which are in colour, are given.

Solidification of Cast Iron.‖—N. Gutowsky has studied, by means of heating and cooling curves, quenching experiments, and microscopic examination, the processes occurring in the solidification and melting of a commercial cast iron containing 3·57 p.c. carbon, 1·32 p.c. phosphorus, 2·05 p.c. silicon. He finds that phosphorus separates as a binary phosphide eutectic. The occurrence of the binary instead of the ternary eutectic required by the theory of ternary alloys, is due to graphite formation. Melting begins with the fusion of the phosphide eutectic at about 980° C. Solidification of the main body of the cast iron is completed at about 1100° C., while the high-phosphorus portion finally solidifies at 944° C., the solidification point of the binary phosphide eutectic. Graphite formation proceeds throughout the solidification range of the binary eutectic mixed crystals-cementite.

* Engineering, lxxxvi. (1908) p. 115 (from Rev. Gén. Sci.).
† Tom. cit., pp. 340–3 (16 figs.). See also Electrochem. and Met. Industry, vi. (1908) pp. 459–61. ‡ Tom. cit. p. 772 (8 figs.).
§ Metallurgie, v. (1908) pp. 431–62, 471–89 (61 figs.).
‖ Tom. cit., pp. 463–70 (27 figs.).

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on the 17th of February, 1909, at 20 Hanover Square, W., Sir E. Ray Lankester, K.C.B., F.R.S., etc., President, in the Chair.

The President said he wished, on taking the Chair for the first time, to thank the Fellows of the Society very much for the honour they had done him in electing him the President of the Society. It was just fifty years since his dear father occupied that position, and the remembrance of that fact gave him additional pleasure in accepting the honour which they had conferred upon him.

The Minutes of the Meeting of January 20th, 1909, were read and confirmed, and were signed by the President.

The List of Donations (exclusive of exchanges and reprints) received since the last Meeting, was read, and the thanks of the Society were voted to the Donors.

	From
C. U. Maalöe, Histopathologiske Studier over Processus Vermiformis (with summary in English) and Portfolio of Plates. (8vo, Copenhagen, 1908)	*The Author.*
E. J. Spitta, Microscopy. 2nd Ed. (8vo, London, 1909)	*The Author.*
Eugen, Warming, Botany of the Faeroes. (8vo, Copenhagen and Christiania, and London, 1901–1908)	*The Author.*
The Darwin-Wallace Celebration. (8vo, London, 1908)	*The President & Council of The Linnean Society.*
A Wilson Screw-barrel Single Pocket Microscope, made by E. Culpeper .. .. A Small Wilson Screw-barrel Single Pocket Microscope, made by George Sterrop .. .. A Simple Pocket Microscope, made by Banks .. .. A Lieberkuhn "Transparent Solar Microscope," made by Dollond	*Mr. E. Heron-Allen.*
Six Slides of Foraminifera from the Adriatic, mounted on the points of needles so that the specimens can be rotated	*Mr. E. Heath.*

A description of the four Old Microscopes presented by Mr. Heron-Allen was read by Dr. Hebb.

A paper "On the 'Red Snow' Plant (*Sphærella nivalis*)," by Dr. G. S. West, was read to the Meeting by Dr. Hebb, and is printed in the Journal of the Society for February 1909, pp. 28–30.

The President, in asking for remarks on this paper, said that he had seen this alga in alpine regions, particularly in a small lake near Grindelwald, which in the autumn was found to be full of it, but he had never seen it on the snow.

A paper by Mr. A. A. C. E. Merlin, "On a German-Silver Portable Microscope made by Powell in 1850," was taken as read—the instrument in question not having been sent to the Meeting.

Mr. E. M. Nelson's paper, "On the Measurement of very Minute Microscopic Objects," was read by Mr. J. W. Gordon.

Dr. Spitta said, did Mr. Nelson make a definite statement in his paper as to what were the objects which could be seen, but were too minute to be photographed—did he give any instance?

The thanks of the Society were voted to Mr. Nelson for his communication.

The following letter from Dr. M. D. Ewell, in reply to the criticisms made upon portions of his paper, "On the Present Status of Micrometry," read at the November Meeting of the Society, was read by Mr. J. W. Gordon:—

THE AMERICAN MICROSCOPICAL SOCIETY,
January 11*th*, 1909.

MY DEAR MR. GORDON,

I am very much gratified that my paper excited so much criticism. Irrespective of its merits, it has accomplished its purpose. I wish to thank each of the gentlemen whose remarks appear in the Proceedings, for their interest in the paper.

Some of the criticisms are well taken, and some, it seems to me, are, owing to misapprehension of my objects and methods, not well taken.

The absolute values, as suggested by Mr. Conrady, are of the greatest value to the user of the scale; but it was not my object to standardise these scales, but only to show their want of agreement with each other. As a matter of fact, however, the results published will, I think, be found not far out of the way if the total lengths are computed from the micrometer values given in the paper. In 1882 the American Microscopical Society procured a standard centimeter "Cm. A" on platin-iridium divided to millimeters, the first millimeter to tenths, and the first one-tenth to hundredths of a millimeter. This was standardised by the United States Coast Survey (the Bureau of Weights and Measures) and also by Prof. W. A. Rogers, and others. The stage and filar micrometers used by me in this investigation were calibrated by direct comparison with "Cm. A," the mean of many series of readings, running into thousands, being used. As to the powers used, I am satisfied from long experience that there is no advantage in the use of high powers in metrology. See the results of several series of measurements in 1885–1889, published in the Proceedings of the American Society of Microscopists.

Mr. Cheshire is in error in stating that no attempt had been made to utilise the same part of the (filar) micrometer screw for the different measurements. Perhaps the work is open to criticism in using different filar micrometers, though I think not, as they were each and all very carefully calibrated on a well determined unit *of the same length as the unit measured, always using the same part of the screw.* I was very particular about this. The error, if any, from this source must be very small, if not insensible; but, if existing, it was a *constant* affecting all alike, and hence unimportant in *relative* measurements such as these were. Again, the differences of the micrometer readings are given in nearly every instance, the first reading being usually zero or so near it as to involve no error of the screw. The screws themselves are excellent for their purpose. Their errors were not magnified by the whole optical combination, as were the stage micrometers; and, so used, their errors were insensible.

Now, as to micrometers used. None except "Cm. A" were selected rulings, but mainly such as I could buy in open market or borrow from friends. My own were not selected from the outset, but purchased in open market and carefully standardised, or were ruled by myself on the Rogers engine which I owned for over ten years. These were carefully ruled on the same part of a carefully calibrated screw; and were no better and no worse than others ruled on the same machine.

Now as to glass micrometers. My experience is that if the lines are filled with fine graphite, and then covered with balsam, they will not deteriorate if the balsam is kept carefully sealed in. The graphite, unfortunately, will not always fill in the lines with perfect uniformity; but some portions of the scale can easily be found which will furnish good lines. Personally I prefer a metal surface or a line ruled through a thin film of silver on glass, sealed with balsam, and covered. These last are elegant. I have never seen any except those made by myself. Zeiss uses this sort of surface in his Abbe test plate, but I make use of a much thinner film, so thin, in fact, as to be translucent. The trouble with realgar is that there is no guarantee of permanency; and it is disquieting to find a micrometer upon which one has bestowed a large amount of research, become so impaired as to invalidate all one's work. I have micrometers ruled on glass, the line filled with graphite, and others ruled through silver on glass covered as above stated, that I have used for fifteen years, and they are still as good as when first ruled.

There is one other item I wish to refer to, viz., the probable error. The tables given furnish the data for computing this error, and I think I sent you in a later communication the probable error of one or more of the series. The labour of computing the probable error of all was more than I felt able to undertake at the time the work was completed. The probable error does not take count of constant errors, and, under the appearance of great accuracy inferred from a small probable error, may lie concealed constant errors of unknown magnitude. These errors I have taken great pains to eliminate, whether or not with entire success is not for me to determine.

In conclusion, I wish again, through you, to thank the Society for the candid and entirely fair manner in which my paper has been criticised. I expected and desired it. Candid criticism is much more valuable than praise to me. It has disclosed weak points which I shall endeavour to correct in future work.

Very respectfully yours,

M. D. Ewell.

Mr. F. Enock then gave a lecture "On the Transformation of certain Insects," which he illustrated by a number of very excellent lantern slides—the species dealt with being those which were common in suburban gardens, and were useful in the destruction of noxious insects. Commencing with views of the common Aphides, or green fly, he showed how these were attacked and destroyed by the larvæ of Lace-wing flies and Hover flies, the metamorphoses of which were subsequently traced. The destruction of Aphides and of injurious larvæ by various species of ichneumon were also described and illustrated. The ravages of the minute black-currant mites (*Phytopti*) were mentioned, and views shown both of the creature, and the result of its presence in the buds of the black currant bushes. The common "Devil's Coach-horse" (*Ocypus oleus*), frequently regarded with aversion, and destroyed when seen, was shown to be an extremely useful insect in destroying injurious caterpillars. Illustrations of "Fairy flies" (Mymaridæ) concluded a very interesting and instructive lecture.

The President said he had been much delighted with Mr. Enock's beautiful pictures, and his wonderful descriptions of the habits of the insects illustrated, from personal observations.

A vote of thanks to Mr. Enock for his interesting lecture was unanimously carried.

A paper "On the Fresh-water Crustacea of Algeria," by Mr. Gurney, was communicated to the Meeting by Mr. D. J. Scourfield, who gave a brief résumé of its contents, the more technical parts of which would be printed in due course in the Journal, where the paper would be printed *in extenso.*

The following Instruments, Objects, etc., were exhibited :—

The Society :—A Wilson Screw-barrel Single Pocket Microscope, made by E. Culpeper : a Small Wilson Screw-barrel Single Pocket Microscope, made by George Sterrop : a Simple Pocket Microscope, made by Banks ; a Lieberkühn "Transparent Solar Microscope," made by Dollond ; and six Slides of Foraminifera from the Adriatic, mounted on the points of needles.

Mr. F. Enock :—Lantern Slides shown on the Screen illustrating his lecture on the Transformation of Insects.

New Fellows :—The following were elected *Ordinary* Fellows of the Society : Albert Ashe, Charles Emanuel Heath, Massey D. E. G. Lyon, Walter Scott, Wilber Fred Willis.

MEETING

Held on the 17th of March, 1909, at 20 Hanover Square, W., E. J. Spitta, Esq., M.R.C.S., etc., Vice-President, in the Chair.

The Minutes of the Meeting of February 17, 1909, were read and confirmed, and were signed by the Chairman.

The List of Donations to the Society since the last Meeting (exclusive of exchanges and reprints) was read as follows:—

	From
Stanislav-Hlava, Monographie der Familie Melicertidæ. Arch. für die Naturw. Landes. forsch. von Böhmen, xiii. No. 2. (8vo, Prag, 1908)	*Sir Frank Crisp.*
Charles Janet, Anatomie du Corselet et Histolyse des Muscles Vibrateurs, après le Vol Nuptial, chez la Reine de la Fourmi (*Lasius niger*). Text and plates. (8vo, Limoges, 1907)	*The Author.*
Leon Fredericq et Jean Messart, Notice sur Leó Errera. (8vo, Bruxelles, 1908) Recueil d'Œuvres de Leó Errera. Botanique Générale. 2 vol. (8vo, Bruxelles, 1908, 1909) Recueil d'Œuvres de Leó Errera. Melanges, Vers et Prose. (8vo, Bruxelles, 1908)	*Madame Errera.*
A New $\frac{1}{12}$-in. Oil-immersion Objective	*Mr. E. Leitz.*

The thanks of the Society were unanimously voted to the Donors, especially to Messrs. Leitz for the $\frac{1}{12}$-in. objective.

A vote of thanks was also passed to Mr. C. L. Curties for the loan of a number of Microscopes under which objects in illustration of the papers were exhibited in the room.

The Chairman said that Mr. Leitz had sent him one of the new $\frac{1}{12}$-in. objectives for examination, and he had subjected it to some very severe tests, but found it to be a very excellent lens. The corrections were carried out in quite a different manner from the usual formula, and he had written to Mr. Leitz saying that he very warmly congratulated him upon the excellence of what he had produced.

Mr. C. Lees Curties exhibited C. Baker's New Model D.P.H. Microscope, two forms of which were shown: one having the mechanical stage built on to the instrument, and the other with plane square stage. The limb is cast in one piece, and has an opening in which the fingers can be placed when lifting. The fine-adjustment is worked by milled heads at either side of the limb. These instruments are provided with either a rackwork centring substage, plane rack substage, or screw focusing substage. A third instrument, similar to the others but of smaller size, with the fine-adjustment actuated by one milled head only, was also shown.

The Chairman said the handle seemed just now to be infecting all the makers, and he was sure that anyone who had to carry a Microscope about without such a handle must find it particularly painful to the fingers; and in putting the instrument away, a handle which did not interfere with the fine-adjustment was a great advantage. He was very glad to find that the makers were beginning to introduce this. He thought, also, that having the fine-adjustment made so that it could be worked from both sides would often be found a great convenience, and Mr. Curties was to be congratulated upon having introduced this new model.

Mr. Rousselet said that the addition of this convenient handle to a Microscope was not a particularly recent invention, for John Cuff made a handy Microscope with a handle about 1750.

Dr. J. W Evans, LL.B., F.G.S., gave a lecture on "The Optical Examination of a Crystal Section in a Rock Slice," which was illustrated by a large number of lantern slides and also by a projection polariscope. devised by Mr. Cheshire. Having shown and explained the construction and use of polarising Microscopes—both those with the analyser in the usual position above the objective, and those with it placed above the eye-piece—he described a systematic method of determining the different crystallographic and optical directions in the section by bringing them in turn parallel to the right and left cross wire, the direction of vibration in the lower nicol. Each direction is denoted by the index-reading when it is in this position, and all the particulars are embodied in a sketch representing the position of the section when the index-reading is zero. The interference colours due to the relative retardation of the light vibrating in the two directions of "extinction" were shown in the case of crystal plates, mica steps, and quartz wedges. On the addition of a prism the spectra of these colours were obtained, showing them to be due to the presence of dark bands which moved from the violet to the red end in ever-increasing numbers, as the thickness of the crystal increased. The method of calculating the thickness of a crystal plate from the interference colours shown by a known mineral was explained, as was also that of ascertaining the birefringence of an unknown mineral from the colours it exhibits, and the thickness of the rock-slice. The application of the Becke method of determining the relation of the refractive index of adjoining minerals was also explained, as well as the use of immersion liquids in order to obtain the exact refractive index of minerals on the margin of a slice by determining that of the liquid which has the same refractive index, by means of the Abbe or Herbert Smith refractometer.

The Chairman having been obliged to leave the Meeting before the conclusion of the lecture, the Chair was at his request afterwards occupied by Mr. A. N. Disney, who moved a hearty vote of thanks to Dr. Evans for his lecture. This, on being put to the Meeting, was carried unanimously.

Mr. C. F. Rousselet read a paper "On *Synchæta fennica* sp. n., and on the Resting-egg of *S. pectinata*." Specimens of *S. fennica* and *S. bicornis*, also a drawing with which the paper would be illustrated, were exhibited in the room.

The thanks of the Society were voted to Mr. Rousselet for his paper.

The following Instruments, Objects, etc., were exhibited :—

Dr. John W. Evans :—Lantern slides shown upon the screen in illustration of his lecture.

Mr. F. Cheshire :—Polarising effects projected upon the screen in illustration of Dr. Evans' lecture.

Mr. J. W. Ogilvy :—New $\frac{1}{12}$-in. oil-immersion objective, made by E. Leitz.

Mr. C. F. Rousselet :—Mounted specimens of *Synchæta fennica* and *S. bicornis.*

New Fellows.—The following were balloted for and duly elected *Ordinary* Fellows of the Society :—Messrs. Arthur Harold Wyld Cleave, Frederick Henry Dodd, Albert P. Porter, David L. Zook.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

JUNE, 1909

TRANSACTIONS OF THE SOCIETY.

X.—*On the Fresh-water Crustacea of Algeria and Tunisia.*

By Robert Gurney.

(*Read February* 17, 1909.)

Plates VII. to XIV.

In the following paper I propose to give the results of the examination of collections made during a visit to Algeria and Tunisia in February and March 1906. Thirty-one days in all were spent in the country, and collections were made in Algiers, Constantine, Biskra, and Hammam Meskhoutine in Algeria, and in the neighbourhood of Tunis, as opportunity offered.

The weather of early February was bitterly cold and wet, snow falling heavily on our arrival in Algiers, and so heavily on the high plateaux as to block the line to Constantine for some days. It is probable that the coldness of the spring retarded the appearance of the Entomostraca to some extent, so that my earlier collections were poorer in species than they should have been. It was probably for this reason that I found no specimens of *Apus* or *Estheria* at Biskra, though nauplii of the latter were met with. On the other hand the abundance of rain provided pools of water which, in a drier season, would not have existed. The conditions are so different in the dry and wet seasons of the year that it is difficult for a stranger visiting the country to form a true idea of the usual state of affairs.

The fresh-water Crustacea of Algeria are better known than those of any other part of Africa, but, even here, a great deal of work remains to be done. The Ostracoda contained in my collections have not yet been worked out, and will not therefore be referred to on this occasion.

The following is a description of the localities in which collections were made:—

I. ALGERIA.

Algiers.

The neighbourhood of Algiers proved singularly barren. The only pools in which anything living was found were some artificial ponds in the Jardin d'Essai. These ponds are supplied with water brought from the hills above the town, and are used for the cultivation of aquatic plants such as *Papyrus*. The following is a list of the species found:—

Asellus aquaticus Linn.
Simosa vetula O.F.M.
Ceriodaphnia reticulata Jur.
Pleuroxus aduncus Jur.
Chydorus sphæricus O.F.M.
Cyclops albidus Jur.
C. prasinus Fisch.
C. bicuspidatus Claus. var. *lubbocki* Brady.
C. strenuus Fisch.

Biskra.

The oasis of Biskra is the capital of the Central Zab district of the Lower Sahara. It is situated on the very edge of the desert, 124 m. above sea-level. The water supply of the oasis is derived from two sources, the River or Oued Biskra, and from springs. The supply from the river is one of very fluctuating quantity, and entirely ceases during the summer. In winter and spring the whole river channel, which is some 400 yards wide, may at times be filled by a turbid torrent, making it difficult to realise that its waters at this point can fail entirely. The essential source of water is therefore the springs, which rise in and by the bed of the river itself, in several groups, $2\frac{1}{2}$ kilometres to the north of the town. Those of the left bank supply the oasis of Filiach, while those of the right bank supply Biskra itself. The water of these springs rises evidently from the cretaceous rocks of the Atlas Mountains, and reaches the surface at a temperature of 29·33° C. (84·8° F.) and with about 2·16 grm. of dissolved salts per litre; it flows along the river bed, which would otherwise be quite dry during the summer, and is directed by means of a low masonry barrage into the main supply canal of Biskra. A large part of the water is doubtless lost by percolation through the gravel of the river bed, but the total volume available amounts to about 10,000 litres a minute. One-tenth of the whole is taken by a special canal for the needs of the town and garrison, the rest being available for the oasis itself. An additional canal, the "Canal des Crues," was dug in 1878 to catch and utilise the flood-water of the river, but its supply is necessarily uncertain and intermittent. The main canal sends branches all over the oasis, and these branches, or seguias, subdivide till every parcel of land is supplied with water, the surplus finding its way into ponds and finally into the desert at the south of the oasis. The watering of the palms is effected by means of pools dug at the foot of each tree, or group of two or three. These pools are filled at varying intervals according to the season, in summer (June to September) about every seven days, in winter about every sixty-one days, and in spring (February to May) every twenty-five days. The amount of water allowed per palm for each watering is about 3 cubic metres, the annual supply working out at about 72 cubic metres per palm. These pools are usually quite small, about 4 metres square in extent, but vary in size according as they supply one palm or more than one; they always have a muddy bottom and rarely contain any vegetation, one or two being seen with a little *Nitella*. The typical association of species found in them consists of *Branchipus pisciformis, Macrothrix hirsuticornis, Cyclops bicuspidatus* var. *lubbocki, C. diaphanus, Cypris virens* and *Herpetocypris reptans,* but other species are also found occasionally. In seventeen pools examined in Biskra sixteen species were found, of which the following is a list, with their frequency expressed as occurrences per 100 collections. The fauna of these pools appears to be the same as in the neighbouring oases of Oumach and Sidi Okbar.

Table showing the Crustacean Fauna of Seventeen Palm Irrigation Pools in Biskra, and the Relative Frequency of the Occurrence of the different Species.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Frequency per cent.
Daphnia magna		+	+				+									+		24
Ceriodaphnia dubia ..															+	+		12
Macrothrix hirsuticornis	+	+	+		+			+	+									35
Alona elegans											+							6
Chydorus letourneuxi			+												+	+		18
Cyclops bicuspidatus ..	+			+	+	+			+				+			+		41
C. diaphanus		+					+			+		+					+	30
C. planus																+		6
C. viridis															+			6
Diaptomus wierzejskii											+	+						12
Cyprinotus incongruens											+							6
Cyprinotus sp.												+						6
Cypris virens		+	+	+	+	+	+	+	+	+			+					59
Herpetocypris reptans		+	+					+	+					+				30
Branchipus pisciformis			+	+	+	+	+	+	+	+	+	+	+	+		+	+	83

The periodical drying up of the pools might be expected to make them suitable only for species with a very short life-cycle, or capable of surviving dry periods, and it is probably for that reason that Cladocera, with exception of *Macrothrix hirsuticornis*, are not usually found. The occurrence of the latter is difficult to explain, inasmuch as it was only once found reproducing sexually; it is possible that the species maintains itself in some parts of the irrigation channels and is introduced afresh into the pools when they are filled.

Besides these palm-pools, I investigated three large ponds which probably owed their existence to the superabundance of water at that time, and are probably dry in summer. These were:—

1. *Kasbah pond.*—The old Turkish fort, or kasbah, at the south of the oasis, is surrounded by a deep depression filled with water forming a large pond divided into three parts by causeways. This pond contained little vegetation, but a rich fauna, particularly of Ostracods.

List of species:—

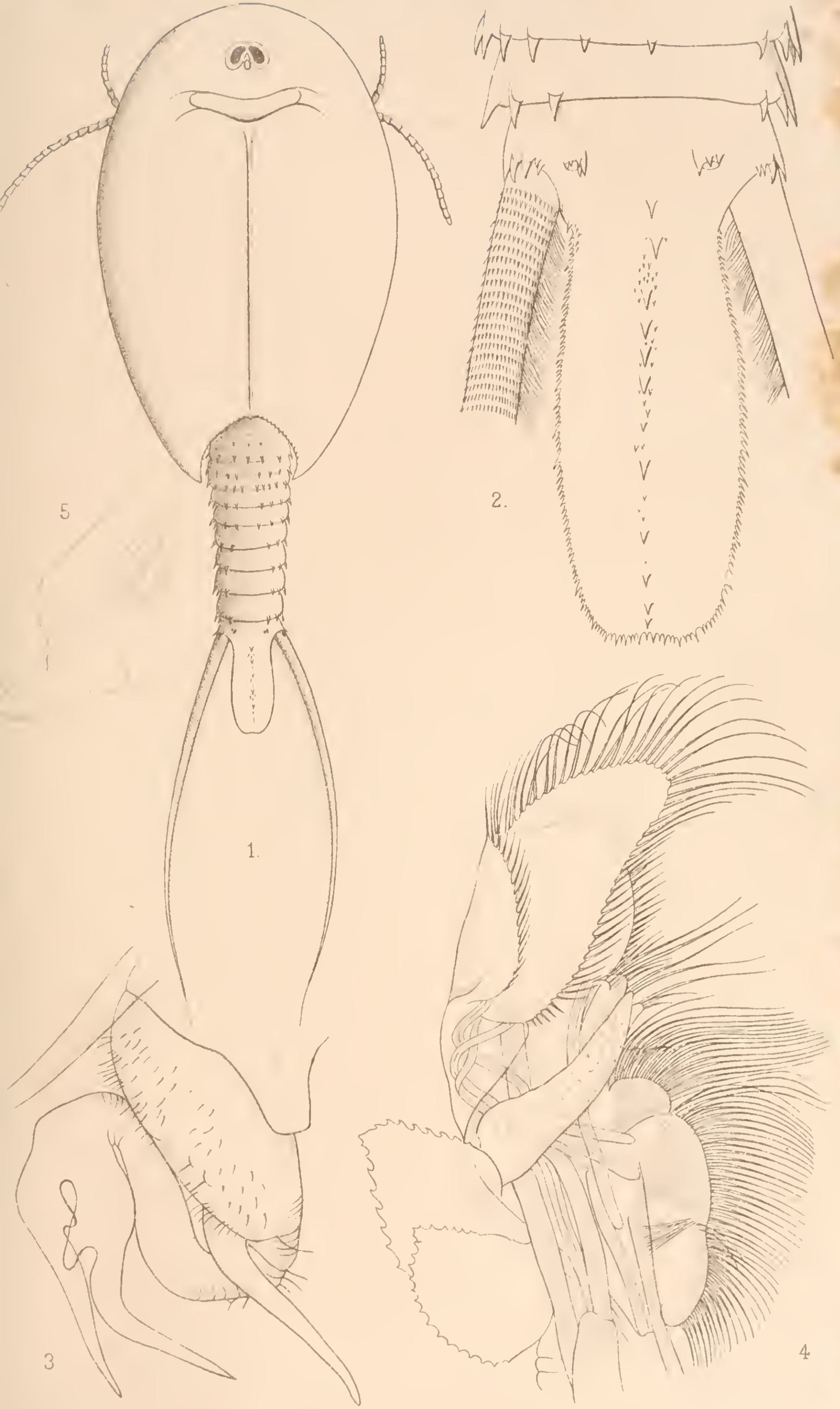
Daphnia magna Strauss.
Ceriodaphnia dubia Rich.
Macrothrix hirsuticornis Norm. and Brady.
Alona elegans Kurz.
Cyclops diaphanus Fisch.
C. bisetosus Rehb.
C. planus sp. n.
Diaptomus chevreuxi De Guerne and Rich.
Branchipus pisciformis Schaeff.
Estheria sp. (larvæ).

2. *Frog pond* (plate VII.).—This name seems appropriate from the immense number of frogs inhabiting the pond, which is situated among the palms in the western part of the oasis. Here there was a rich vegetation.

EXPLANATION OF PLATE VIII.

Fig. 1.—*Lepidurus lubbocki*. Female. × 3.
,, 2.—Ditto. Tail-plate. × 15.
,, 3.—*Streptocephalus bimaris* sp. n. Male. Second antenna. × 37.
,, 4.—Ditto. Female, 6th leg. × 26.
,, 5.—Ditto. Female, tip of egg-sac. × 30.

Frog-pond, Biskra.



R Gurney del. ad nat.

West, Newman lith.

List of species:—

Daphnia magna Strauss.
Ceriodaphnia dubia Rich.
Alona elegans Kurz.
Dunhevedia crassa King.
Chydorus letourneuxi Rich.
Cyclops prasinus Fisch.
C. diaphanus Fisch.
C. bicuspidatus var. *lubbocki* Brady.
Branchipus pisciformis Schaeff.

3. *Beni Mora pond.*—This is a large shallow pond with little vegetation close to the racecourse at Beni Mora, on the north-west of Biskra.

List of species:—

Daphnia magna Strauss.
Macrothrix hirsuticornis Norm. and Brady.
Alona elegans Kurz.
Cyclops diaphanus Fisch.
C. bicuspidatus var. *lubbocki* Brady.
Diaptomus wierzejskii Rich.
Branchipus pisciformis Schaeff.

About six kilometres west of Biskra is the hot spring of Hammam Salahin, and in its neighbourhood are two crater-like depressions full of highly saline water. The water is said to be of the same nature as that of the springs supplying Biskra, but concentrated by evaporation, and might have been expected to contain Entomostraca. However, neither here, nor in any other saline water in the neighbourhood, did I find any trace of Entomostraca of any kind. In one of these "crater lakes" a few Coleoptera, Mollusca, and the fish *Cyprinodon fasciatus* Val., which also lives in the hot water flowing from the baths, were found. The water was rich in Diatoms, the following species having been identified by Mr. Morland, to whom I wish to express my thanks:—

Surirella striatula Turpin.
Pleurosigma elongatum Smith.
Synedra tabulata Kutz.

The Rotifer *Notholca striata* (kindly identified for me by Mr. Rousselet) also occurred in some numbers. This Rotifer and all the Diatoms are species characteristic of brackish water.

Sources d'Oumach.—The springs which supply the oasis of Oumach rise about 10 kilometres south-west of Biskra and about the same distance from Oumach, which lies to the south of Biskra. There are three springs, differing somewhat from each other in nature. The first, which is called Aïn-el-Hadjar, springs from a hole in the base of a mass of limestone rock, and has an output of about 1800 litres a minute at a temperature of 26° C. according to my own observation. The water is very clear, rather sulphurous to the taste, but of normal density. The bed of the outflowing stream is covered with small stones, under which were found swarms of *Gammarus simoni*, and, at the mouth of the spring, a few specimens of a *Cirolana* which I have described as *Cirolana fontis*. Another spring, or group of springs, known as Aïn-el-Faouar, are apparently of similar origin to the Aïn-el-Hadjar. The third group, named Aïn Mogloub, lies a little to the east. Here there are two large springs having the form of more or less round pools, the one about 4 metres across, the other smaller, and both very deep and clear. The bottom is all shifting sand, and there is a sort of film of white which ever and again spreads over the bottom of the pool and draws back again. The spring is intermittent, now bubbling furiously and now sinking quiescent, but with no regular periodicity comparable to that of geysers or the so-called tidal wells of Australia and other places. An Arab assured me that the water comes from the sea; but, however that may be, it is here quite fresh and drinkable, with a temperature of 26·33° C. In the outflow from this group several specimens of *Palæmonetes varians* were found. The water from all the springs is collected into an artificially embanked channel which leads straight over the desert to Oumach. In this channel *Potamon fluviatilis* and *Barbus callensis* abound, while *Tilapia zillei* was found in the Aïn Mogloub and in the outflow of Aïn-el-Hadjar. *Palæmonetes varians* probably occurs sparingly throughout the length of the channel, as it was found, in the first instance, by Lord Walsingham about five kilometres from the springs.

II. TUNISIA.

Oued Tindja.

Oued Tindja station is about thirty miles north-west of Tunis, betwen the lakes of Garaa Achkel and Bizerta. Garaa Achkel is a great lake surrounded by hills on three sides and with a barren sandy shore. At the time of my visit the water was fresh to the taste and to the salinometer, and was at an unusually high level. It was said to have been 3 metres above its usual level a short time before, but was then falling. We were told that during winter and spring this lake contains fresh water and has an outflow into Lake Bizerta, but that, during summer, owing to evaporation, the level sinks and there is an inflow of salt water from Lake Bizerta. No Entomostraca were found in the lake, the only Crustacea seen being a species of *Sphæroma* and *Gammarus locusta*. Shells of *Cardium* were picked up on the shore, so that it is probable that the fauna is a brackish- rather than a fresh-water one. A thorough investigation of the lake would prove of great interest. A very strong stream was flowing out at the north-west end of the lake into the Oued Tindja, and at this point, in a backwater, *Gobius rhodopterus* and *Anguilla vulgaris* were found abundant, and a large species of *Balanus* was found upon some wooden posts. Close to the outflow there is a large, weedy marsh, swarming with frogs, and with a rich Entomostracan fauna.

List of species:—

Macrothrix hirsuticornis Norm. and Brady.
Alona elegans Kurz.
Chydorus sphæricus.
Cyclops strenuus Fisch.
C. planus sp. n.
C. serrulatus Fisch.
Canthocamptus trispinosus Brady.
Diaptomus numidicus sp. n.
Poppella guernei Rich.

The following species were found in a large pond not far from this point:—

Daphnia chevreuxi Rich.
Ceriodaphnia dubia Rich.
Simosa vetula Müll.
Moina rectirostris Jur.
Macrothrix hirsuticornis Norm. and Brady.
Chydorus sphæricus.
Cyclops macrurus Sars.
C. viridis Jur.
C. diaphanus Fisch.
C. planus sp. n.
C. bicuspidatus var. *lubbocki* Brady.
Canthocamptus staphylinus Jur.
Diaptomus incrassatus Sars.
D. weirzejskii Rich.
D. ingens sp. n.
D. cyaneus sp. n.
Estheria cycladoides Joly.
Streptocephalus sp.

Near the station, on the east of the line, the soil is sandy and dune-like, and among the dunes there were some small rain-pools, which were remarkable for containing four species of Phyllopods, besides several other species of Entomostraca.

List of species:—

Daphnia chrevreuxi Rich.
D. atkinsoni Baird.
Simosa vetula Müll.
Ceriodaphnia dubia Rich.
Moina rectirostris Jur.
Alona elegans Kurz.
Cyclops viridis Jur.
C. bicuspidatus var. *lubbocki* Brady.
Diaptomus incrassatus Sars.
D. cyaneus sp. n.
D. wierzejskii Rich.
Lepidurus lubbocki Brauer.
Estheria cycladoides Joly.
Chirocephalus diaphanus Prev.
Streptocephalus bimaris sp. n.

Sidi Athman.

Sidi Athman is a station on the line to Bizerta about fourteen miles north-west of Tunis. On the east there stretches a large marshy plain called Garaet-el-Mebtouh, which is part of a great depression following the course of the Oued Medjerdah to the sea at Lake Porto Farina, and extending between Djebel Amar on the south and Djebel Kechabta on the north. The level at Sidi Athman is given on the map as 8 metres. At the time of my visit there was an unusual amount of water on the marsh, while in places the road itself was inundated. Away to the north a large sheet of water was seen, which could not be reached owing to the boggy character of the ground. Close to the road there are drainage ditches and small ponds with abundance of vegetation, notably *Ranunculus aquatilis*, and harbouring a rich fauna. The following are the species found here:—

1. In roadside ditch:

Daphnia atkinsoni. ♂ and eph. ♀. Abundant, many of the young showing the characters of *D. bolivari* Rich.
Daphnia magna Strauss. Rare.

EXPLANATION OF PLATE IX.

Fig. 6.—*Streptocephalus* sp. Head of female. × 37.
,, 7.—Ditto. Base of the setæ on the exopodite of the 6th leg. × 260.
,, 8.—*Branchinecta* sp. Head of female. × 37.
,, 9.—*Daphnia chevreuxi* Rich. Male. × 57.
,, 10.—Ditto. Post-abdomen of male. × 260.

R Gurney del. ad nat

West, Newman lith.

Ceriodaphnia dubia Rich.
Moina rectirostris Jur.
Macrothrix hirsuticornis Norm. and Brady.
Alona elegans Kurz. Rare.
Cyclops diaphanus Fisch. Few.
Diaptomus wierzejskii Rich. Common.
D. incrassatus Sars.
Chirocephalus diaphanus Prev. Common.
Estheria cycladoides Joly. Common.

2. Flooded road:

Daphnia atkinsoni Baird.
Moina rectirostris Jur.
Macrothrix hirsuticornis Norm. and Brady. Abundant. Many males and ephippial females.
Alona elegans Kurz.
Chydorus letourneuxi Rich. Abundant. Ephippial female present.
Cyclops diaphanus Fisch.
Diaptomus wierzejskii Rich.

Sebkhet-er-Riana.

This great salt like lies somewhat to the north of Carthage. Though full of water at the time of my visit, the Sebkha is dry in summer and salt is taken from it by an English company, which, unfortunately, absolutely forbids all approach to its shores, so that I was unable to collect as freely as I should have desired. Judging from pools by the edge of the lake, the fauna is the same as that of most "Chotts," as described by MM. Blanchard and Richard. The salinity of these pools was excessively high—above 1·046, which was the highest reading of my salinometer.

Species found:—

Moina sp. Ephippium.
Marshia blanchardi Rich. Common.
Artemia salina Linn. 7 females and 2 males.

Tunis.

The town of Tunis stands on a ridge which separates the Lake of Tunis from the Salt Lake or Sebkha Sedjouma. The latter, like all salt lakes, is dry in summer, but at the time of my visit was full of water. The lake was then surrounded by a strip of soft and tenacious mud in which the retreating water had left a number of small pools containing water of varying salinity and with a varying fauna. The following table shows the fauna of four such pools:—

Density	1·007	1·013	1·017	1·035
Daphnia atkinsoni	Abundant	Abundant	Abundant	Rare
Moina salinarum	..	..	Common	Rare
Cyclops diaphanus	Common	..	..	..
Diaptomus salinus	..	Numerous	Rare	..
Marshia blanchardi	..	..	Common	..
Branchinecta sp.	..	Larvæ	..	Larvæ

LIST OF SPECIES.

MALACOSTRACA.

Potamon edule Latr.—The fresh-water crab is apparently widely distributed in Algeria and Tunisia, but it was only seen by me in Biskra and its neighbourhood. It seems to hide itself in cold weather, and it was only in spring water which was somewhat warmer than the air that it was noticed. Miss Rathbun has recently (1904) separated the circum-Mediterranean form of *Potamon* (*P. fluviatile* Belon) into three species, *P. edule* Latr., *P. potamoios* Oliv., and *P. setiger* Rathb. The first of these, to which my specimens belong, inhabits Italy, Greece, and Numidia, while the second is found in Egypt, Palestine, Syria, Mesopotamia, and Cyprus, the former being, therefore, the Western and the latter the Eastern form. The separation of an Eastern from a Western Mediterranean form recalls the separation of *Saxicola albicollis* Viell. by Whitaker into an Eastern form, *S. amphileuca* Ehr., and a Western form, *S. albicollis*. The distribution of these two species agrees almost exactly with that of *Potamon potamoios* and *P. edule* respectively.

Palæmonetes varians Leach.—The first specimens of this species found in Algeria were taken by Lord Walsingham, just before my visit, in the conduit supplying the oasis of Oumach. I myself found several more specimens in the outflow of one of the Sources d'Oumach, but it seems to be far from common. It has been recorded from several localities in Tunisia.

Asellus aquaticus Linn.—A few specimens were found in pools in the Jardin d'Essai at Algiers.

Cirolana fontis Gurney.—A description of this interesting species has already been given elsewhere.* Three specimens

* Zool. Anzeig., xxxii. (1908) p. 682.

only were found under stones at the mouth of the spring Aïn-el-Hadjar (Sources d'Oumach) near Biskra.

Sphæroma sp.—A species of *Sphæroma* occurs in Lake Garaa Achkel at Oued Tindja, but my specimens are not sufficiently mature to be identified with certainty. They resemble *S. serratum*, which occurs abundantly along the shore of the Lake of Tunis (in salt water).

Gammarus simoni Chevreux.—This species was found to be common at the mouth of the spring Aïn-el-Hadjar (Sources d'Oumach) about 10 kilometres west of Biskra. My specimens differ in some respects from the description given by M. Chevreux, but the differences are not of great importance. In my specimens the accessory flagellum of the first antenna consists of two or three joints; the fourth segment of the abdomen bears a group of setæ but no spines, the fifth and sixth being as described by M. Chevreux with the addition of a few setæ. The telson differs in that there is no lateral seta. In the form of the head and of the gnathopods in both sexes there is complete agreement. It appears to be a species widely distributed throughout Algeria and Tunisia, and has already been recorded from the neighbourhood of Biskra.

Gammarus pungens M. Edw.*—Found in a small rock-hewn tank in the Gorge of the Roummel at Constantine.

Gammarus locusta Linn.—A few specimens were found living in fresh-water in Lake Garaa Achkel at Oued Tindja.

Corophium volutator Pall.—A few specimens of this species were found in the Oued Tindja at its outflow from the lake in water practically fresh. The species seems to be very adaptable with regard to salinity, since it is found also in Norfolk in places where, for the greater part of the year, the water is perfectly fresh.

Entomostraca.

Lepidurus lubbocki Brauer.—A small number of specimens of a species of *Lepidurus* were found on March 7 in some small pools near Oued Tindja. Through the kindness of Canon Norman I have been able to compare them with a specimen of *L. lubbocki* from Sicily, and have no hesitation in identifying my specimens with that species in spite of certain differences which I think it advisable to mention.

There appears to be a great variability with regard to several of the characters of the species. The differences are as follows:—

1. The nuchal organ is described by Brauer as "fast kreisrund," whereas in Canon Norman's specimen and in my own the outline

* My specimens of this and the preceding species have been submitted to the Rev. T. R. R. Stebbing, who has been kind enough to examine them, and to confirm my identification.

is somewhat elliptic, the proportion of width to length being about 1 : 1·4 (plate VIII. fig. 1).

2. The number of teeth on either side of the posterior emargination of the shell is in the Sicilian specimen 14 to 15, and in mine varies from 17 to 22. Brauer gives the number as about 17.

3. In the Sicilian specimen the proportion of width to length of the tail-plate (plate VIII. fig. 2) is 1 : 1·87, and is given by Brauer as 1 : 2. In my specimens this plate is considerably longer, varying from 1 : 2·2 to 1 : 2·8, with an average of 1 : 2·4. The tip of the plate is emarginate in the Sicilian specimen, and in my own may be evenly rounded, truncate, or emarginate. The number of dorsal median teeth is generally about 7, but may be as many as 11 in addition to many minute denticles. In the Sicilian specimen there are 6.

The form of the tail-plate in young individuals resembles very closely that of the adult *L. glacialis*, as has been pointed out by Brehm with reference to *L. productus*.

L. lubbocki has been found at Bône in Algeria (Simon).

Artemia salina Linn.—*Artemia salina* seems to occur in all the chotts, or salt lakes, of Algeria and Tunisia, but I was somewhat surprised to find that it did not occur in any waters in the immediate neighbourhood of Biskra, whatever their salinity might be. I myself found it only in Chott Tinecilt (Haut Plateau, 2800 ft.), and in Chott El Ariana, near Tunis. Eight adult specimens were collected in a pool by the shore of the latter, of which two were males. The furcal rami of the six females show an extraordinary variety in the number and arrangement of the setæ, the number being generally different in the two rami. The number of setæ on each ramus (including minute teeth) ranges from three to eleven.

Branchinecta sp.—In the salt pools at the edge of Lake Sedjouma, a species of Branchipod was found which I am unfortunately unable to identify. Several larvæ were taken, and one nearly adult female, besides a single male just beginning to show its sexual characters. The following is a description of these two specimens:—

Female: Head and thorax considerably shorter than the abdomen, which consists of nine segments. Segments of the abdomen longer than broad. Furca longer than the last segment

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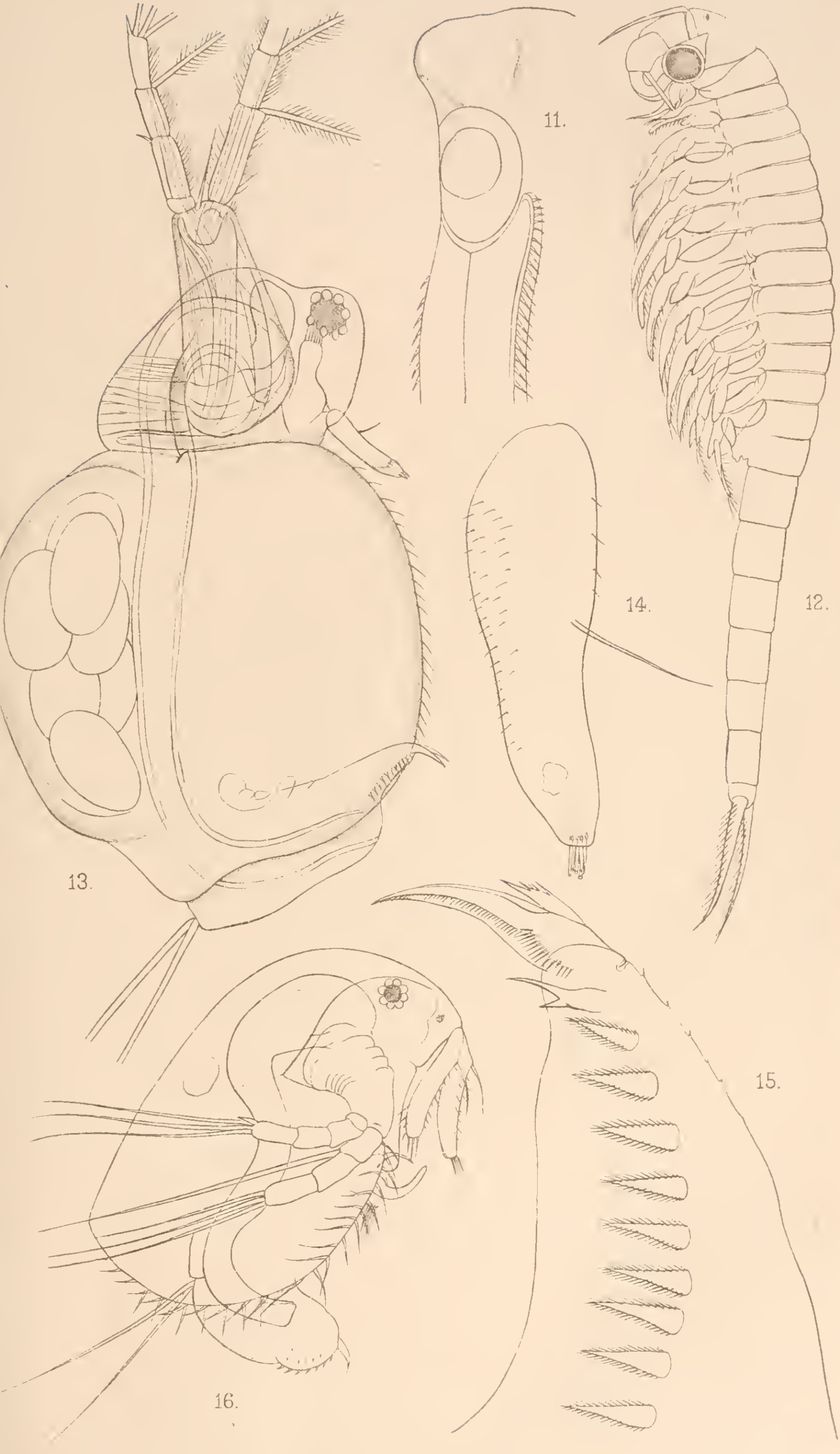
EXPLANATION OF PLATE X.

Fig. 11.—*Daphni chevreuxi* Rich. Head of young male, from dorsal side. × 260.
,, 12.—*Streptocephalus bimaris* sp. n. Male. × 8.
,, 13.—*Moina salinarum* sp. n. Female. × 65.
,, 14.—Ditto. First antenna of female. × 260.
,, 15.—Ditto. Part of the post-abdomen. × 440.
,, 16.—*Macrothrix hirsuticornis* Norm. & Br. Male. × 120.



R. Gurney del. ad nat.

West, Newman lith.

of the abdomen and closely ciliated. Egg-sac not fully developed, shorter than the 3rd abdominal segment, and probably cylindrical when fully formed. Second antenna narrow, flattened, with the external margin prolonged to a point (plate IX. fig. 8). Branchial legs, having the 6th endite somewhat triangular in shape, with a rather pointed apex. Coxal exite single, with a single large notch on its external margin. Base of the setæ of the exopodite and 6th endite surrounded by a ring of minute denticles.

Male: Head and thorax slightly longer than the abdomen. Segments of the latter scarcely longer than broad, the 3rd and 8th having each a pair of small ventral knobs. Furca mutilated, but apparently similar to that of the female. Second antenna not fully developed, but consisting of a stout basal part and a slender distal joint not longer than the basal joint. No frontal appendages. Legs as in the female.

Measurements:—

	Head and Thorax.	Abdomen.	Furca.	Total.
Male ..	4·5 mm.	4·25 mm.	..	8·75 mm.
Female ..	5·25 ,,	6·3 ,,	0·85 mm.	12·4 ,,

It is much to be regretted that adult specimens of this species were not obtained, as the habitat was such that only *Artemia* might have been expected to be found, the density of the water reaching as high as 1·035. It is quite clear that the specimens do not belong to that genus, but I refer them to *Branchinecta* with some doubt. It is possible that they may be immature specimens of *Branchinecta spinosa* M. Edw., which has been found in salt water near Odessa.

Branchipus pisciformis Schaeff.—Nearly all the irrigation pools in Biskra contained *B. pisciformis* in abundance, but it was not met with anywhere except in Biskra, where it was also found by M. Blanchard. M. Simon has recorded its occurrence in Tunisia (1885).

Chirocephalus diaphanus Prevost.—This species was found at Oued Tindja, Sidi Athman, and Rades, in Tunisia. All the individuals belonged to the large race. M. Simon records its occurrence in three places in Algeria. In two of these places the large race was found, and in one (Kef-el-Akdar) the small race.

Streptocephalus bimaris * sp. n.—Female: Body compact and thickset, the head and thorax together exceeding the length of the abdomen without the rami, but about equal to it if the rami are included. Egg-sac large, rather longer than the first five segments of the abdomen, and ending in a short, finger-like process (plate VIII. fig. 5). First pair of antennæ simple, linear appendages; 2nd pair thick and fleshy, somewhat triangular in shape,

* "Between two seas," i.e. between Lake Bizerta and Garaa Achkel.

and ending in a sharp incurved point. In the branchial legs the terminal plate of the endopodite (6th endite) is short and very broad, with a rather well defined inner angle (plate VIII, fig. 4). The fringing setæ are short and spiniform on the inner margin. The exopodite is large, oblong, and considerably longer than the endopodite. Branchial appendix (flabellum) long and pointed, coxal exite (bract) represented by two large lobes so deeply divided from one another as to be nearly separate.

Male: Body as in the female, but the abdomen is about equal in length to the head and thorax together (plate X. fig. 12). The head is produced into a short, blunt rostral process. Furcal rami as in the female. Second pair of antennæ small; the basal part is thick and hairy, and about equal in length to the succeeding flexible part (plate VIII. fig. 3). The terminal part consists of two subequal dactyli, each with a small rounded process on its inner face at its base. Legs as in the female, but with the coxal exite undivided.

Measurements (average):—

	Head and Thorax.	Abdomen.	Furca.	Egg-sac.	Total Length.
Male	7·7 mm.	7·5 mm.	1·8 mm.	..	17 mm.
Female ..	8·1 ,,	6·5 ,,	2·1 ,,	4·2 mm.	16·8 ,,

A few specimens of the species here described were found at Oued Tindja in a pool in company with *Lepidurus lubbocki* and *Estheria cycladoides*. Five females and one male only were preserved. The species is characterised by the simple form of the antennæ and egg-sac of the female, and especially by the form of the branchial legs of the latter. In the Polyartemiidæ and in most species of *Chirocephalus*, the coxal joint of the leg bears two foliaceous exites. In *Chirocephalus stagnalis* the female may have two exites, while the male has one, as in the species here described. On the other hand, no species of *Streptocephalus* has yet been described, so far as I am aware, which has the coxal exite at all divided.

Streptocephalus sp.—A single, not quite mature, female specimen of a species of *Streptocephalus* quite distinct from the preceding one was taken in a weedy pool a few yards away from that in which the latter was found. As I assumed at the time that it belonged to the same species, I made no effort to obtain more specimens. As the specimen seems to belong to some undescribed species, I give here a short account of it.

The body is slender, the head and thorax somewhat exceeding the length of the abdomen. The egg-sac has evidently not attained its full development; its extremity is bifid. The last segment of the abdomen is somewhat wider than the preceding segment and quadrangular in outline. The second pair of antennæ are foliaceous, hairy, and with a small pointed process in the middle of its rounded end (plate IX. fig. 6). The branchial legs are of the usual form, the terminal plate more or less rectangular, and the exopodite very much longer than the endopodite in the legs of the middle of the series. At the base of the setæ of the distal margin of the exopodite is a small bifurcated spine (plate IX. fig. 7).

Measurements :—

Head and Thorax.	Abdomen.	Furca.	Total.
7·0 mm.	6·5 mm.	1·6 mm.	15·1 mm.

Estheria cycladoides Joly.—Abundant at Oued Tindja and at Sidi Athman. Numbers of larvæ, probably belonging to this species of *Estheria,* were found in an irrigation pool in Biskra. According to M. Simon it is widely distributed in North Africa and occurs also in Southern France, Spain and Sicily.

Daphnia atkinsoni Baird.—This species was not found in Algeria, though its ephippium was noticed in a collection taken in Chott Tinecilt while the train stood in Les Lacs station. In the neighbourhood of Tunis it was a common occurrence. In small pools surrounding Lake Sedjouma by Tunis it was found in water having a very high salinity, the density of which varied from 1·007 to 1·035. It was also found in various small pools at Sidi Athman, Oued Tindja, and St. Germains.

While none of the specimens seen are referable to the variety *bolivari* Richard, many, and particularly young individuals, show a distinct transition towards it, having a pronounced dorsal cephalic ring which, in some young individuals, is provided with very minute spines. Some specimens taken at Sidi Athman have the dorsal cephalic ring very distinct but not spinous, while the anterior part of the fornix of the valves is provided with spines as in *D. bolivari.* Males and ephippial females were found on five occasions out of a total of twelve occurrences.

Daphnia chevreuxi Richard.—Found in some numbers at Oued Tindja and also at St. Germains. Males and ephippial females were found on the first occasion.

Whereas in the adult female the head is more or less square in outline, in the young of both sexes the anterior margin of the head slopes upward, meeting the dorsal margin in a sharp, backwardly projecting peak. On the dorsal side just behind this peak there is a small oval disk resembling the nuchal adhesive organs of certain other Cladocera (plate X. fig. 11). The two dorsal rows of spines are continued up to this point, enclosing the posterior half of the disk between them. In the adult both disk and dorsal peak generally disappear, but an ephippial female from Oued Tindja still showed a slight protuberance in the position of the peak. The arrangement of the dorsal spinules in a curve round the disk recalls the dorsal cephalic ring of *D. atkinsoni* var. *bolivari*; in fact young individuals very closely resemble the young of *D. atkinsoni.* M. Richard does not figure the post-abdomen of the male separately, and his figure of the whole animal (plate IX. fig. 9) is misleading. The post-abdomen of the male does not, in fact, differ materially in shape from that of the female (plate IX. fig. 10), but there are fewer and more irregular denticles along the dorsal border and a group of spinules on the small papilla on which the vas deferens opens.

Daphnia magna Strauss.—This species was common in Biskra in irrigation pools and in some of the larger ponds. It was also found in highly saline water by Lake Sedjouma and at Sidi Athman and Radés. The specimens from water of high density showed no differences from the type resembling the varieties found by Schmankewitsch in similar situations.

Simosa vetula (O.F.M.).—Apparently rather a rare species in Algeria and Tunisia. A few individuals were found in ponds in the Jardin d'Essai in Algiers and at Oued Tindja near Tunis.

Ceriodaphnia reticulata Jur.—Found only in an irrigation tank in the Jardin d'Essai in Algiers, and in a pond near Tunis.

Ceriodaphnia dubia Richard.—A species of *Ceriodaphnia* was found rather commonly both at Biskra and in Tunisia, which I rather doubtfully identify with *C. dubia* Richard. With regard to general form, shape of the head, fornix, antennæ, and reticulation of the shell and head, the agreement is complete. The shape of the post-abdomen varies somewhat according to the degree of contraction of the specimen, but in its extended condition it has a tapering form as shown in M. Richard's figure. The claws are long and very distinctly ciliated, the cilia arranged in a proximal and a distal series. The teeth of the dorsal surface are ten or eleven in number and are short, those in the middle of the series being slightly the longest. The only conspicuous point of difference is the presence in some specimens of a very long dorsal process closing the brood-chamber. M. Richard says that in most specimens there is a "prolongement conique court faisant saillie dans la cavité incubatrice," and in many of my adult specimens the same condition is found; there appears to be great variability in the length of this process. There is, however, a great difference between the ephippium in my specimens and that of *C. dubia* as

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EXPLANATION OF PLATE XI.

Fig. 17.—*Macrothrix hirsuticornis* Norm. & Br. First antenna of male. × 260.
,, 18.—Ditto. Post-abdomen of male. × 260.
,, 19.—*Alona elegans* Kurz. Part of shell of ephippial female, showing line of fracture. × 440.
,, 20.—*Chydorus letourneuxi* Rich. Male. × 260.
,, 21.—Ditto. First antenna of male. × 440.
,, 22.—Ditto. Female, portion of shell margin. × 1050.
,, 23.—Ditto. Ephippial female. × 120.

R. Gurney del ad nat.

West, Newman lith.

described by others. In my specimens the ephippium resembles exactly that of some forms of *C. quadrangula*. The ampullary area is covered with small, rather protuberant reticulations, each with a minute chitinous knob in the centre. The remainder of the ephippium dorsal to the ring of air cells is strongly reticulate, with a small rod of chitin projecting from the centre of each mesh. These rods are very conspicuous along the dorsal margin. Gradations can be traced from the condition in the ampullary area, where there is but a minute knob to the condition with well-developed rods. The male does not differ from that of *C. dubia*.

The importance to be attached to the structure of the ephippium as a specific character is uncertain. In *C. quadrangula*, while it is generally spiny, it may also have the normal form. Also Stingelin (1895) has met with one example of a spiny ephippium in *C. pulchella* Sars, so that it appears that this form of shell ornament is not constant, and therefore not of specific importance.

There are two other points of difference between my specimens and *C. dubia*. Firstly, my specimens are very large, some measuring as much as 1·5 mm. in length; and secondly, the adult female carries eggs varying in number from five to eighteen. Both these differences are, however, quite unimportant in comparison with the identity of structure, and are due to the occurrence of the animal in small pools rich in food, instead of in large open waters. The length of the dorsal abdominal process is probably also connected with the larger number of eggs in the brood-pouch.

Moina salinarum sp. n.—Head depressed, the dorsal margin with a slight depression behind the eye (plate X. fig. 13). Frontal angle rather sharp; ventral margin of the head nearly straight. Valves of the shell without any sculpture, fringed with setæ along their ventral margin, and with the posterior margin somewhat sinuate. Eye small, its diameter about one-fourth of the length of the head. First antennæ short and comparatively thick, one-seventh of the whole length of the body (plate X. fig. 14). Anterior seta inserted nearly in the middle of the antenna, and rather more than one-third of the length of the latter. Posterior margin of the antenna fringed with exceedingly delicate cilia, which are not easy to see. Sensory rods very short. Second pair of antennæ stout, the rami shorter than the stem.

Post-abdomen less than half the length of the body, and rather slender. The post-anal part very short, less than one-fourth of the length of the whole post-abdomen. Terminal claws short and stout, the cilia along their edge somewhat stronger at the base, but not forming a comb (plate X. fig. 15). Lateral teeth 10 to 12 in number. Dorsal edge of the pre-anal part covered with delicate cilia, which here and there take an arrangement in transverse rows.

Length 1·35 to 1·8 mm.

Male and ephippial female unknown.

The species here described appears to be very closely related to *Moina micrura* Kurz. The general form of the body and of the post-abdomen are the same, but *M. salinarum* differs from it in being considerably larger, in having more teeth on the post-abdomen, and in having the claws of the post-abdomen armed with denticles, whereas they are smooth in *M. micrura*. These differences are not such as might be caused by adaptation to life in water of high salinity, since such adaptations usually take the form of reduction and simplification of parts. I believe, therefore, that the species is distinct, though it is much to be regretted that the male and ephippial female are not available to put the matter beyond doubt.

Moina rectirostris Jur.—Apparently rather a common species in the neighbourhood of Tunis, being found at Sidi Athman, Oued Tindja and Rades. There is no doubt that my specimens belong to this species, though they differ in some minute points from specimens taken in England. In all essentials the agreement is exact. The only striking point of difference is the presence of seven hooks on the first antenna of the male instead of the normal number of five. The difference is remarkable since the number of sensory setæ and other outgrowths of the first antenna of Cladocera is not as a rule subject to variation.*

Macrothrix hirsuticornis Norman and Brady.—This is the commonest of all the Cladocera found in Algeria and Tunisia, being met with in nearly every pool in Biskra and its neighbourhood, and also in various places near Tunis. As is frequently the case among the *Macrothricidæ*, this species seems very rarely to reproduce by means of resting-eggs, although it inhabits, in Biskra, at all events, pools of water which become dry periodically at short intervals. If resting-eggs are not produced in these circumstances it seems almost incredible that the species should be able to persist. And yet I met with ephippial females in only one of the irrigation pools examined. Males and ephippial females were found in shallow flood-water covering a road at Sidi Athman near Tunis and in a roadside ditch at Rades. Lilljeborg (1900) states that the male and ephippial female are unknown.

The male is much smaller than the female, measuring 0·35 to 0·5 mm. The head is very large, rather more than one-third the length of the whole body (plate X. fig. 16). In general shape it is more or less rectangular, the dorsal and ventral margins of the shell-valves nearly straight, the posterior margin forming a rounded angle with the dorsal margin. The eye is not larger than that of the female. The first pair of antennæ are nearly as long as the head, curved, and not dilated at their extremities (plate XI.

* See Scourfield, The Olfactory Setæ of the Cladocera, Journ. Quekett Micr. Club, ii. vi. 1896. Die sogenannten Riechstäbchen der Cladoceren, Plöner Forschungsberichte, xii. 1905.

fig. 17). They are fringed with cilia, and bear, near the head, two lateral setæ. Of these the longest reaches beyond the extremity of the antenna. There are nine terminal sensory rods. The hook of the first pair of legs projects beyond the shell-valves and has three minute tubercles at its extremity. A strong spiniform seta springing from the stem opposes itself to the claw so as to form a sort of chela. The post-abdomen does not differ much from that of the female except that the ventral edge of it in front of the claws projects as a rounded prominence upon which the vas deferens opens (plate XI. fig. 18).

Ephippial females vary much in size, measuring from 0·6 mm. to 1·3 mm. in length. The ephippial area occupies the greater part of the shell-valve, and differs from the remainder only in its slightly darker colour and in showing no visible reticulation. The surface simply appears to be very dirty. In moulting, the whole of the valve separates from the head. A faint line can be traced, dividing the ephippial area from the ventral reticulated part of the shell, and the shell probably splits eventually along this line. The ephippium contains two or three small oblong resting-eggs. They lie together enveloped in a delicate membrane, which represents the inner layer of the shell, and imbedded in what appears to be cellular tissue. Unfortunately my specimens are not sufficiently well preserved to determine the nature or origin of this tissue.

Alona elegans Kurz.—Commonly found in Biskra in all the larger ponds which do not rapidly dry up. It was once found also in one of the small pools at the foot of the palms. In Tunisia it occurred at Sidi Athman, Oued Tindja, and Rades, so that it may be considered as a common North African species. Males and ephippial females were found on four occasions, three times in Biskra and once at Sidi Athman.

The ephippium presents certain features which are of some interest. The ephippium becomes, as is usual, of a deep brown colour, but the surface markings of the shell are not changed, though they are rather more prominent. The outline of the ephippium is marked by an unusually conspicuous "line of weakness," composed of large reticulations following the line of the ephippial margin (plate XI. fig. 19). The striations of the ventral part of the shell end abruptly against this line, bending round in the anterior half to meet it more or less at right angles. The ephippium differs from that of most Lynceidæ in shape since it includes scarcely any part of the posterior margin of the shell, resembling, in this respect, that of *Alonopsis ambigua*. In the majority of species only a greater or lesser portion of the ventral margin is thrown off, so that the ephippium includes the greater part of the shell.*

* Scourfield, 1902.

Pleuroxus aduncus Jurine.—A few specimens found in the fountain basin, and in a tank in the Jardin d'Essai in Algiers.

Chydorus sphæricus O.F.M.—A rare species, found only at Algiers and Oued Tindja. Its place seems to be taken by the next species.

Chydorus letourneuxi Richard.—This species was found in several of the irrigation pools in Biskra, and in pools at Sidi Athman in Tunisia. Males and one ephippial female were among the specimens taken at the latter place.

The ephippium resembles that of *Chydorus barroisi* * in that the dorsal chitinous thickening extends up nearly the whole length of the back. The ephippial area is dark and strongly reticulated, with the surface finely punctate, but I am unable to detect a definite line of fracture, and have no knowledge of the shape of the ephippium when shed. There appears to be a crumpled inner membrane enclosing the egg (plate XI. fig. 23).

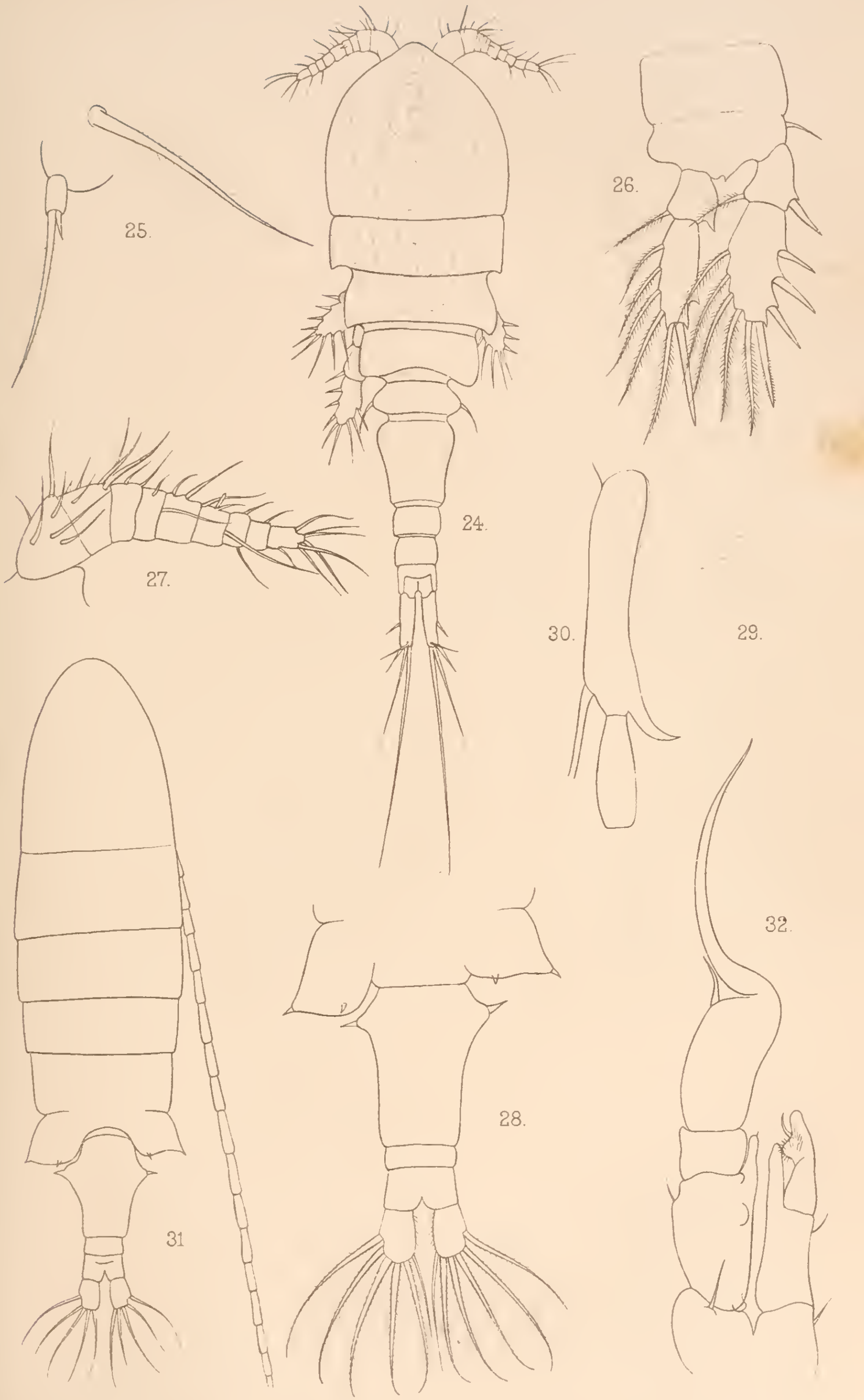
The male is much smaller than the female, measuring about 0·35 mm. in length and 0·26 mm. in greatest width (plate XI. fig. 20). The shape of the shell does not differ much from that of the female, but the ventral margin is rather more prominent. The first antenna is short and thick, with two lateral sensory setæ and nine terminal sensory rods (plate XI. fig. 21). The prehensile appendage bears a strong, sharply bent claw, which has two minute recurved teeth at its extremity. The anterior edge of the appendage is thickly fringed with cilia arranged in transverse rows. The post-abdomen is similar to that of the female both in shape and in arrangement of the delicate cilia. The ventral edge of the valves is spinous, as in the female, but the spines are not, in either sex, outgrowths of the shell itself. They are really the thickened bases of the setæ which fringe the valves (plate XI. fig. 22).

Dunhevedia crassa King.—There can be no doubt that *D. setigera* Birge is identical with *D. crassa* King, as Stingelin has shown. The sole important difference between the two species appears to lie in the greater or lesser sculpturing of the shell, the form of the

* Scourfield, 1902, fig. 35.

EXPLANATION OF PLATE XII.

Fig. 24.—*Cyclops planus* sp. n. Female. × 98.
,, 25.—Ditto. 5th foot of female. × 540.
,, 26.—Ditto. 3rd foot. × 260.
,, 27.—Ditto. 1st antenna. × 260.
,, 28.—*Diaptomus numidicus* sp. n. Abdomen of female. × 98.
,, 29.—Ditto. Rostral processes of female.
,, 30.—Ditto. Joints 23 and 24 of right antenna of male. × 260.
,, 31.—Ditto. Female. × 57.
,, 32.—Ditto. 5th legs of male. × 150.



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upper lip and of the post-abdomen being identical. The sculpture is certainly variable, and may be present in Asiatic individuals. Specimens from Calcutta which I have examined show a reticulation which, though faint, is as distinct as that of many of my specimens from Algeria. *D. neglecta* Daday is only distinguishable from this species by a slight prominence in the anterior margin of the upper lip, and in this respect forms a transition to *D. odontoplax* Sars, in which the anterior margin is provided with a tooth-like projection.

D. crassa was found to be abundant in a pond in Biskra, which I call the "frog pond," by reason of the multitude of frogs living in it.

Cyclops planus sp. n.—Female: Body flattened and tapering gradually without any abrupt transition between thorax and abdomen. Segments of the thorax separated by rather deep indentations (plate XII. fig. 24). The first abdominal segment broad, as long as the remaining segments together; the furcal rami about as long as the last two segments of the abdomen together. The proportional lengths of the furca and its setæ may be expressed thus—

Furca	.. ..	20
Setæ:—Outermost	.. ..	11
,, 2nd	.. ..	33
,, 3rd	.. ..	104
,, 4th	.. ..	8

The lateral setæ are inserted about the middle of the furca.

The first pair of antennæ (plate XII. fig. 27) short, reaching about half-way along the first segment of the thorax, and consisting of nine segments only. The proportional lengths of the joints are as follows:—

Length ..	11	6	4	3	5	4	3	4	5
Joints ..	1	2	3	4	5	6	7	8	9

The third joint is partially divided into two: the sixth joint, corresponding to the 12th–14th of the 17-jointed antenna, bears a sensory club.

All the swimming legs have both branches 2-jointed; the last joint of the exopodite of the third leg bears three lateral spines and one terminal spine, while the last joint of the endopodite has a single terminal spine (plate XII. fig. 26). The last joint of the exopodite of the fourth leg has two lateral and one terminal spine. The fifth leg (plate XII. fig. 25) consists of a single cylindrical joint armed with a minute spine and a long terminal seta. The egg-sacs are closely pressed to the abdomen and contain few eggs. The form of the receptaculum seminis is not clearly distinguishable, but appears to consist of an elongated oval sac with two narrow lateral arms at the anterior end. The spermatophores are so attached that they diverge obliquely from each other like the two arms of a V.

Length: to base of furca 0·7 mm.; to end of furca 0·755 mm.

This species resembles *C. diaphanus* in some respects, but appears to be quite distinct from it in the form of the body, antenna, and receptaculum seminis.

It occurred rather frequently in Biskra and at Oued Tindja in Tunisia.

Cyclops strenuus Fischer.—Found only in the Jardin d'Essai in Algiers and in a large pond at Oued Tindja.

Cyclops bicuspidatus Claus.—Common in small pools at Algiers, Biskra, and near Tunis, in water both fresh and salt. But, whatever the salinity might be, the specimens found always belonged to the variety *C. lubbocki* Brady, with fourteen joints in the antennæ.

Cyclops bisetosus Rehberg.—Found in four irrigation pools in Biskra. One female was noticed with eighteen joints in the antenna.

Cyclops viridis Jurine.—Palm irrigation pools in Biskra, in pools by the conduit of Oumach, and at Oued Tindja.

Cyclops albidus Jurine.—This seems to be a rare species, and was only found in the Jardin d'Essai in Algiers and in Chott Tinecilt in the high plateau.

Cyclops serrulatus Fischer.—A few immature females of this species were found at Oued Tindja in a marsh by the river. They appear to belong to the form *C. varius* Lillj., but cannot be identified with it with certainty.

Cyclops prasinus Fischer.—Taken in the Jardin d'Essai in Algiers and in pools in Biskra and Sidi Okbar.

Cyclops diaphanus Fischer.—This is by far the commonest species of *Cyclops* found. It occurred in palm irrigation pools at Biskra and Sidi Okbar, in large ponds at Biskra, in the River Seybouse at Hammam Meskhoutine, at Carthage, Sidi Athman, Oued Tindja, and in brackish water at Tunis (Lake Sedjouma).

Canthocamptus pygmæus Sars.—A number of individuals of this species were collected in a tiny trickle of water at Hammam Meskhoutine.

Canthocamptus minutus O. F. Muller.—A single female and a male were found in a pond at Oued Tindja. While obviously belonging to this species, these specimens differ from the type in the possession of an exceedingly large spine on either side of the last segment of the abdomen.

Canthocamptus trispinosus Brady.—A few individuals were collected in a marsh at Oued Tindja.

Marshia blanchardi Richard.—This species occurred in very salt water only by Lake Sedjouma, at Oumach, Radès, and El Ariana. M. Richard suggests that the presence of this and other species of Harpacticids in the Algerian Sahara may be adduced as evidence of the existence of a quaternary inland sea. On the other hand these minute Crustacea are so easily dispersed that it is more reasonable to suppose that these species have recently colonised the inland waters which they have found suitable by reason of their high salinity. There appears to be overwhelming evidence that the Algerian Sahara has not recently been covered by the sea, but rather that there was, in late Pliocene and Quaternary times, a Lacustrine period in which rivers and great fresh-water lakes existed in the Sahara. The chotts are the sunken relics of these lakes, the water of which has become progressively salter. With the increase of salinity of the Saharan lakes they became suitable for the colonisation of brackish species, such as *Cardium edule* and certain Harpacticids. *Cardium* has now disappeared, since the water of the chotts is too salt for it. Had the Harpacticids been relics of an ancient sea it is probable that they would now be represented by species peculiar to the district, whereas the only species not yet found elsewhere is *Mesochra lybica* Blanch. and Rich.

Diaptomus incrassatus Sars.—This species was found in some numbers in pools and ditches at Sidi Athman and Oued Tindja near Tunis. Through the kindness of Canon Norman I have been able to compare my specimens with co-types sent to him by Prof. Sars, so that I feel no doubt as to their identity. The only difference of any importance that can be detected lies in the form of the rostral filaments. In specimens from Mongolia these are long and tapering, whereas in mine they are short, broad at the base, and abruptly contracted distally into fine points. In my specimens the genital segment is slightly broader and has a minute spine on either side.

The species has not been found hitherto elsewhere than in Central Asia, where it appears to be widely distributed and tolerant of a rather high salinity. Its occurrence in Tunisia is comparable to the occurrence in North Africa of *Hemilepistus reaumuri*, which belongs to a genus of Isopods confined, with one other exception, to Central Asia.

Diaptomus numidicus sp. n.—Body rather slender, the greatest width near the middle of the thorax (plate XII. fig. 31). Last segment of the thorax in the female expanded into sharply pointed lobes. Abdomen of the female composed of three segments; the genital segment more than twice as long as the last two combined, not greatly expanded, and with a small spine on either side (plate XII. fig. 28). In the male the fourth segment is slightly asymmetrical, overlapping the fifth segment on the right side.

Furcal rami symmetrical in both sexes. Rostral processes distinct but small. First pair of antennæ in the female reaching considerably beyond the furca. In the male the penultimate joint of the prehensile antenna bears a short hook and a very narrow hyaline membrane (plate XII. fig. 30). The 14th, 15th, and 16th joints each have a short, strong spine (plate XIII. fig. 34).

The fifth foot of the female has the endopodite one-jointed and half as long as the first joint of the exopodite (plate XIII. fig. 33); the third joint of the latter is distinct and well developed, bearing a short spine and a seta which reaches nearly the end of the spinous process.

In the right foot of the male (plate XII. fig. 32) the second basal joint bears two minute cuticular processes; the endopodite is equal to the first joint of the exopodite; the second joint of the latter has no cuticular processes; and the lateral spine is very short and near the end of the joint. In the left leg the basal joint has no cuticular processes; the endopodite is longer than the first joint of the exopodite; the second joint of the latter is prolonged into a short, blunt process. The third joint is represented by a short seta.

Measurements:—

	Female. Length, mm.	Male. Length, mm.
Sagittal	1·47	1·34
,, with furca	1·54	1·41
Thorax	1·14	0·92
Abdomen	0·33	0·42
,, 1st segment	0·23	0·08
,, 2nd ,, ...	0·04	0·09
,, 3rd ,, ...	0·06	0·105
,, 4th ,, ...	..	0·09
,, 5th ,, ...	..	0·055
Furca	0·07	0·07
Left antenna	1·69	1·26

A few specimens of the species here described were found in a pool at Oued Tindja in company with *Poppella guernei*. The resemblance between them and *D. drieschi* Poppe and Mrazek on the one hand and *D. steindachneri* Richard on the other is so close that I have been in much doubt as to whether the species should

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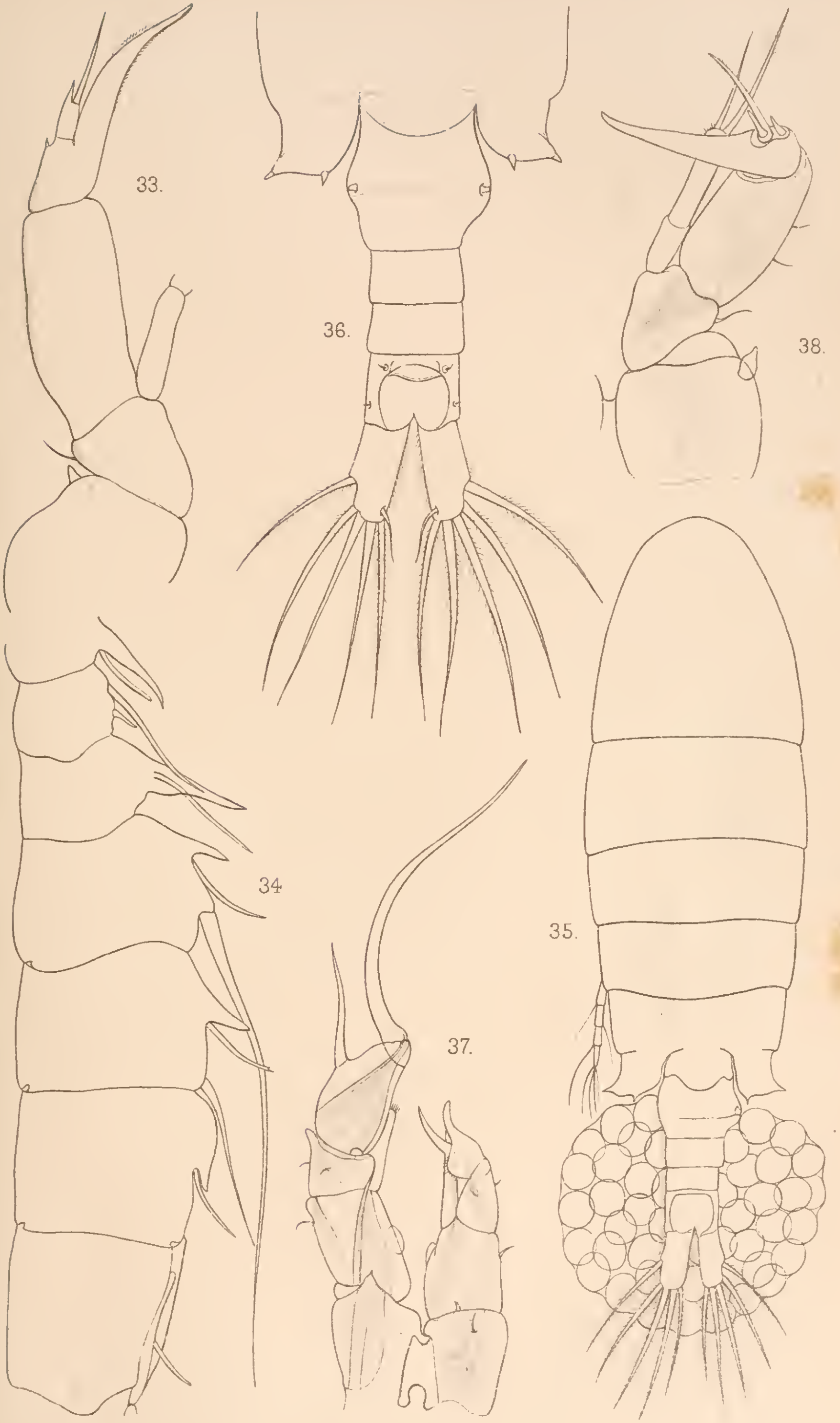
EXPLANATION OF PLATE XIII.

Fig. 33.—*Diaptomus numidicus.* 5th leg of female. × 260.
,, 34.—Ditto. Part of right antenna of male. × 260.
,, 35.—*Diaptomus cyaneus* sp. n. Female. × 37.
,, 36.—Ditto. Abdomen of female. × 65.
,, 37.—Ditto. 5th legs of male. × 98.
,, 38.—Ditto. 5th leg of female. × 150.



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be considered as distinct. While the form of the body and of the fifth feet in the female seem to agree exactly with those of *D. steindachneri*, the prehensile antenna and the fifth feet of the male present differences which are very striking. The description given of *D. drieschi* is somewhat imperfect, but a comparison of the fifth feet, in both sexes of the two species, seems to make specific identity impossible. The relationship between *D. numidicus* and *D. steindachneri* is very close, and they seem, together with *D. drieschi* and *D. vulgaris*, to form a group of nearly connected species.

Diaptomus cyaneus sp. n.—Female: Body stout, the greatest width being in the first free thoracic segment (plate XIII. fig. 35). Last segment of the thorax with small lateral lobes pointed at their outwardly directed apices and with a small posterior spine (plate XIII. fig. 36). Rostral processes rudimentary. Abdomen short, its length, including the furcal rami, equal to the greatest width of the thorax. Genital segment scarcely dilated, with a minute blunt spine on either side. A distinct line of division runs across the dorsal face of it, making the abdomen to consist of five segments. Furcal rami about twice as long as broad, ciliated on their inner edge and sometimes on the outer edge also.

The antennæ reach, when reflexed, as far as the last segment of the thorax.

Fifth pair of legs with the basal joint bearing a short broad tooth (plate XIII. fig. 38). Endopodite two-jointed, the proximal joint the shorter, equalling the first joint of the exopodite in length. At its apex are two long slender spines of unequal length. Third joint of the exopodite distinct though very small, bearing two unequal spines. The egg-sacs contain very numerous small eggs, as many as 60 or 70 being counted.

Male:—Body tapering little anteriorly. Last segment of the thorax symmetrical; abdomen and furcal rami symmetrical. Last segment of the prehensile antenna without a hook. Penultimate joint with a small process one-third the length of the succeeding joint (plate XIV. fig. 39). Hyaline membrane present, but very narrow. The 14th, 15th, and 16th joints bear setæ and sensory rods only.

Fifth pair of legs (plate XIII. fig. 37).—In the right leg the basal joint bears a small hyaline membrane; the endopodite is slender, much longer than the first joint of the exopodite. Second joint of the exopodite short and broad, the long lateral spine inserted beyond the middle. In the left leg the second basal joint has a small hyaline process. The endopodite is longer than the first joint of the exopodite. Second joint of the latter forms a rounded hairy pad on its inner surface, and is produced into a finger-like process having a striated hyaline membrane on its inner edge. Third joint (inner spine) long and stout, with a similar membrane.

Measurements (averages):—

	Male. Length, mm.	Female. Length, mm.
Sagittal	2·28	2·47
,, with furca	2·5	2 66
Thorax	1·64	1·96
Abdomen, total	0·63	0·51
,, 1st segment	0·12	0·20
,, 2nd ,, ...	0·15	0·112
,, 3rd ,, ...	0·135	0·102
,, 4th ,, ...	0·135	0·097
,, 5th ,, ...	0·09	..
Furca	0·235	0·18
Left antenna	1·89	1·95

This species was found in considerable numbers in pools at Oued Tindja near Tunis. It is of a bright blue colour, the colour persisting in some preserved specimens but fading in others.

Diaptomus chevreuxi Guerne and Richard.—The specimens described under this name by Guerne and Richard were found in the high plateau region on the road from Algiers to Laghouat. I found it to be common in ponds at Biskra, but it did not occur in any of my collections in the coastal, or Tell region.

Diaptomus wierzejskii Richard.—This species appears to be common and widely distributed in Algeria and Tunisia. It was common at Biskra, and also at Sidi Athman and Oued Tindja, near Tunis.

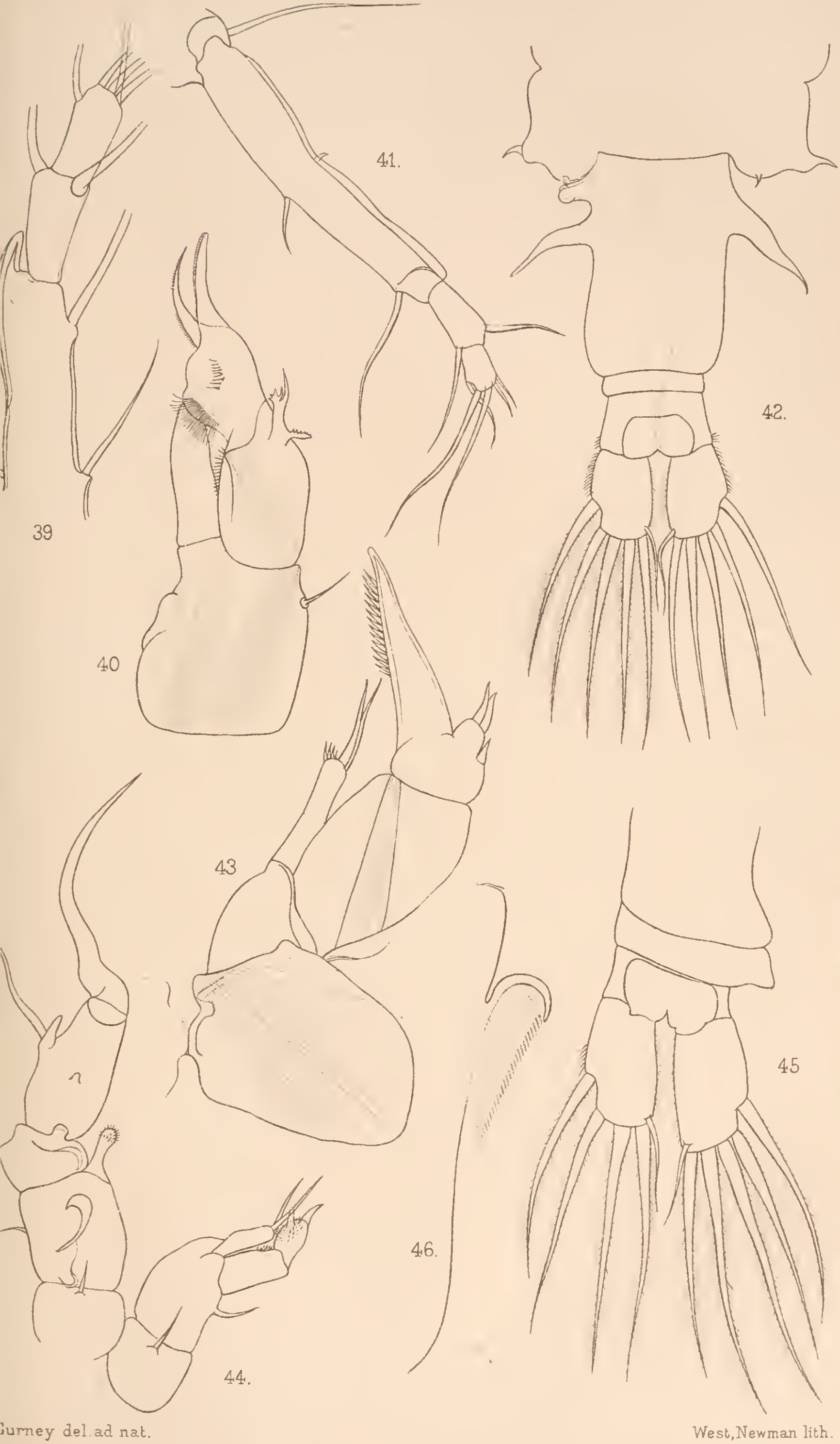
Diaptomus salinus Daday.—This species was found only in Lake Sedjouma, by Tunis, and in salt pools by the shore of the lake. These pools had a density of 1·013–1·017.

In one male specimen a slight, but rather curious, abnormality was noticed. The first joint of the exopodite of the left fifth foot bears a peculiar stout spine with a basal branch and a terminal cluster of teeth. This joint does not, as a rule, bear either a spine or a seta (plate XIV. fig. 40).

Diaptomus ingens sp. n.—Female: Body robust, the greatest width falling in the first segment of the thorax. Last segment

EXPLANATION OF PLATE XIV.

Fig. 39.—*Diaptomus cyaneus*. Terminal joints of right antenna of male. × 260.
,, 40.—*Diaptomus salinus* Dad. Abnormal left 5th foot of male. × 260.
,, 41.—*Diaptomus ingens* sp. n. Terminal joints of right antenna of male. × 98.
,, 42.—Ditto. Abdomen of male. × 37.
,, 43.—Ditto. 5th leg of female. × 70.
,, 44.—Ditto. 5th leg of male. × 98.
,, 45.—Ditto. Abdomen of male. × 57.
,, 46.—*Poppella guernei* Rich. Margin of the 24th joint of the antenna of the female. × 1050.



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of the thorax not completely fused with the preceding segment, not greatly expanded laterally, but with its outer angles acute. Abdomen of three segments only; the genital segment more than twice as long as the two succeeding segments together, bearing on the left side anteriorly a short rounded knob and on either side a long stout spine (plate XIV. fig. 42). These two spines are not exactly symmetrical either in size or position. Second segment of the abdomen very short, scarcely one-third of the length of the third segment. Furcal rami broad, the breadth greater than half the length, ciliated on both sides. Frontal filaments absent. First pair of antennæ reach, when reflexed, to the end of the thorax. The fifth pair of legs (plate XIV. fig. 43) have the endopodite slender, indistinctly two-jointed, nearly equalling in length the first joint of the exopodite. The apex of it bears two long setæ and a few small spines. Third joint of the exopodite distinct, bearing two short, subequal spines.

Male: Shape as in the female, but somewhat more slender and tapering posteriorly. Third and fourth segments of the abdomen produced asymmetrically on the right side (plate XIV. fig. 45). Prehensile antennæ bears a stout spine on the fifteenth and sixteenth joints, but no spine on the fourteenth. Penultimate joint with a narrow hyaline lamella not produced at the distal end into a hook (plate XIV. fig. 41). Terminal joint without a hook. Fifth pair of legs (plate XIV. fig. 44). Right leg has a large bilobed hyaline lamella on the second basal joint. Endopodite short and club-shaped; second joint of the expodite with the lateral spine inserted nearly in the middle, with a hyaline process at its base. Terminal claw comparatively short and finely serrated. Left leg with endopodite cylindrical, 1-jointed, as long as the first joint of the exopodite and bearing at the end two long setæ. Second joint of the exopodite rather elongated, and with a hairy pad and short distal spine; inner spine, corresponding to the third joint, short and stout.

Length, female 5 to 5·5 mm.; male, 4 to 4·5 mm.

This very large species resembles in many respects *Diaptomus roubaui* Richard, but differs strikingly from it in some points. It differs from it in the form of the genital segment, which in *D. roubaui* is produced on the right side into a rounded process. In the fifth foot of the female the spines of the third joint of the exopodite are much shorter than in *D. roubaui*, and the endopodite is a little longer. There is a considerable agreement in form between the fifth feet of the male in the two species, but *D. roubaui* lacks the hyaline membrane of the second basal joint of the right foot and the long setæ of the endopodite of the left foot. The abdomen of the male is exactly the same in both.

My specimens were found in a pool at Oued Tindja.

Poppella guernei Richard.—A few specimens of this peculiar species were found in a marshy lake by the outflow of the Lake Garaa Achkel at Oued Tindja. The water was perfectly fresh.

The species was found by M. Richard in a fresh-water canal in southern France, but has also been recorded by Sars from the Caspian Sea, and by Van Douwe from Transcaspia and Turkestan. Its distribution is therefore peculiar both geographically and biologically, since it occurs both in fresh-water and also in water of very high salinity (Bay of Karabugas).

Professor Sars has stated his opinion that the large double-toothed plate on the posterior face of the second joint of the fifth foot in the female figured by Richard is nothing more than the terminal part of the newly-formed leg as seen just before the moult. Van Douwe has, however, fully confirmed Richard's description by the examination of Transcaspian specimens, and my own show the existence of the toothed plate as clearly as possible. Viewing the anterior face of the leg, this plate, as seen through the leg, has a remarkably close resemblance to the third joint of the latter, and might easily give rise to error. It is, of course, possible that the Caspian form is a distinct species.

A small anatomical point has not been mentioned by either Sars or Van Douwe. On the inner face of the twenty-third and twenty-fourth joints of the antenna in the female, there is a very delicate hyaline lamella, or rather "stiftchensaum," since its delicate striation indicates that it is composed of excessively fine cilia. This lamella is supported distally by a peculiar, highly refringent, curved rod of chitin (plate XIV. fig. 46).

Conclusion.

Much work has already been done on the fresh-water Crustacea of North Africa, particularly by M. Richard and Professor Sars, who have worked largely on material supplied by M. Chevreux. Compared with those of Algeria, the Crustacea of Tunisia have been somewhat neglected, but my own collections, though I spent but a few days in that country, are sufficient to show that the fauna of the coast region, or Tell, is very rich and will repay closer investigation. I think it worth while to give here what I believe to be a complete list of the species hitherto recorded from Algeria and Tunisia. I have included in it all the species found by me, and have indicated roughly the distribution of each one.

LIST OF SPECIES FOUND IN ALGERIA AND TUNISIA.

	Numidia only.	Palæarctic Region (remainder of).	Nearctic Region.	Neotropical Region.	Ethiopian Region.	Oriental Region.	Australian Region.
Potamon edule Latr.		+					
Palæmonetes varians Leach		+					
Atyaephyra desmaresti Millet		+					
Caridina nilotica Roux		+			+		
Asellus aquaticus Linn.		+	+				
Cirolana fontis Gurney	+						
Gammarus pulex L.		+					
G. simoni Chevr.	+						
G. pungens M. Edw.		+					
G. tunetanus Sim.	+						
G. locusta Linn.		+	+				
Orchestia gammarellus Pall.		+					?
Talitrus saltator Mont.		+					
Niphargus rhipidiophorus Catta		+					
Pseudoniphargus africanus Chev. ..	+						
Corophium volutator Pall.		+					
Artemia salina Linn.		+	+			+	
Branchinecta salina Daday	+						
Branchinecta sp.	+						
Branchipus pisciformis Schaeff.		+					
Chirocephalus diaphanus Prév.		+					
C. recticornis Brauer	+						
Streptocephalus rubrocaudatus Klunz.					+		
S. bimaris Gurney	+						
S. sp.	?						
Apus cancriformis Schaeff.		+					
A. numidicus Grube					+		
Lepidurus lubbocki Brauer		+					
Estheria cycladoides Joly		+					
E. angulosa Simon	+						
E. mayeti Simon	+						
Diaphanosoma brachyurum Liev. ..		+	+	+			
Daphnia magna Strauss..		+	+		+		
D. atkinsoni Baird		+	+				
D. chevreuxi Rich.	+						
D. acuminirostris Lucas..	+						
D. obtusa Kurz		+	+	+			
Simosa vetula O.F.M.		+	+	+			
S. exspinosa Koch		+	+				
Scapholeberis mucronata O.F.M.		+	+	+		+	
Ceriodaphnia megalops Sars		+	+				
C. reticulata Jur.		+	+	+			
C. dubia Rich.				+			+
Moina macrocopa Strauss		+	+				
M. rectirostris Jur.		+	+				
M. salinarum Gurney	+						
Macrothrix hirsuticornis Norm. & Br.		+		+			
Lathonura rectirostris O.F.M.		+	+				
Alonopsis ambigua Lillj.		+					
Alona tenuicaudis Sars		+	+	+		+	
A. elegans Kurz		+					

List of Species found in Algeria and Tunisia—*continued.*

	Numidia only.	Palaearctic Region (remainder of).	Nearctic Region.	Neotropical Region.	Ethiopian Region.	Oriental Region.	Australian Region.
A. rectangula Sars		+	+	?			
A. guttata Sars		+	+	+	+	+	
Leydigia acanthocercoides Fisch.		+	+	+		+	
Pleuroxus aduncus Jur.		+		+		?	
Dunhevedia crassa King		+	+	+	+	+	+
Chydorus sphæricus O.F.M.		+	+	+	+	+	+
C. letourneuxi Rich.		+					
Cypris ungulata Moniez	+						
C. virens Jur.		+	+				
C. incongruens Ramd.		+	+				
C. blanchardi Moniez	+						
C. fischeri Lillj.		+					
C. mareotica Fisch.		+					
C. bispinosa Luc.		+					
C. phaseolus Luc.	+						
C. balnearia Moniez	+						
Herpetocypris reptans Baird		+	+				
Cyprinotus fragilis Brady	+						
C. prasinus Fisch.		+					
Stenocypris chevreuxi Sars	+						
Ilyocypris gibba Ramd.		+	+				
I. australiensis Sars						+	+
Cypridopsis villosa Jur.		+		+			
Candonopsis complanata Brady	+						
Diaptomus lilljeborgii G. & R.		+					
D. chevreuxi G. & R.	+						
D. salinus Dad.		+					
D. wierzejskii Rich.		+					
D. incrassatus Sars		+					
D. cyaneus Gurney	+						
D. ingens Gurney	+						
D. numidicus Gurney	+						
Poppella guernei Rich.		+					
Cyclops bicuspidatus Claus		+	+				
C. albidus Jur.		+	+	+		+	+
C. strenuus Fisch.		+		+			
C. prasinus Fisch.		+		+	+	+	
C. diaphanus Fisch.		+					
C. viridis Fisch.		+	+				
C. macrurus Sars		+		+			
C. serrulatus Fisch.		+	+	+	+	+	+
C. planus Gurney	+						
C. aequoreus Fisch.		+					
Canthocamptus pygmaeus Sars		+					
C. yahiai Bl. & Rich.	+						
C. minutus O.F.M.		+					
C. trispinosus Brady		+		+			
Marshia blanchardi Rich.		+					
Mesochra lybica Bl. & Rich.	+						
Laophonte mohammed Bl. & Rich. ..		+				+	
Dactylopusia jugurtha Bl. & Rich. ..						+	
Belisarius viguieri Maupas		+					

This list of species recorded from Algeria and Tunisia is an extensive one compared to any list that could be compiled for any other part of Africa. The great majority of these species were taken in the Tell or coast region, mainly in the neighbourhood of Bône, but scattered observations have been made all over the country from Oran to Tunis and as far south as Ouargla.

The close connection existing between both the fauna and flora of North Africa and those of the southern parts of Europe has been abundantly demonstrated by many authors, and the conclusions of the botanists and zoologists are borne out by those of geologists. It is not, therefore, to be expected that the Crustacea should do otherwise than confirm the generally accepted opinion. Furthermore, the Entomostraca, with their generally wide, and yet often perplexing distribution, are not by any means a good group from which to draw zoogeographical evidence. It is, however, remarkable, in view of their immense powers of dispersal, that they do in fact point in the clearest possible way to the independence of North Africa from the rest of the continent, and its zoological affinity with Europe. The only species which, outside Numidia, are found only in Southern Africa, are *Apus numidicus* Grube and *Streptocephalus rubricaudatus* Klunz. The latter really hardly affects the question, as it has only been found in Algeria between Ouargla and Temassinim, near the boundary of the Palæarctic and Ethiopian regions. A peculiar feature of the Entomostracan fauna is the presence of certain species hitherto found only in Asia or Australia. These are *Diaptomus incrassatus* Sars, which is recorded only from Central Asia, *Dactylopusia jugurtha* Blanch. and Rich. from Siam, and *Ilyocypris australiensis* Sars from Queensland and Ceylon. *Ceriodaphnia dubia* Rich. is found in Sumatra, New Zealand, Chili, Patagonia, and Tierra del Fuego, but not in South Africa as yet.

The countries bordering the Western Mediterranean have faunistic relations which have led Dr. Forsyth Major to unite them in a province called by him "Tyrrhenis,"* and it is a characteristic of this province that many of its representative species, either existing or extinct, have Oriental or South American affinities.† The species just mentioned provide further evidence of such affinity. Further, the species of *Diaptomus* which I have called *D. numidicus*, seems to be most nearly related to *D. steindachneri* from Albania, and *D. drieschi* from Ceylon. *D. ingens* is related to the Spanish *D. roubaui* and to *D. amblyodon*, which extends from Austria to Siberia.

The Entomostraca of Numidia indicate, therefore, an intimate connection between North Africa and Western Europe, and suggest

* See R. F. Scharff, European Animals, London, 1907, pp. 212–30.

† Loc. cit.

that there has been an immigration of Eastern forms following the Northern coast of the Mediterranean, as stated by Professor Engler.*

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XI.—*On the Recent and Fossil Foraminifera of the Shore-sands at Selsey Bill, Sussex.*—II.*

By Edward Heron-Allen, F.L.S., F.R.M.S., and Arthur Earland.

(Read April 21st, 1909.)

Plates XV., XVI.

In the first paper of this series, which we had the honour to read before this Society in June, 1908, we gave a short account of the nature, position, and extent of the deposits, both recent and fossil, which we had searched, particularly with reference to the newly discovered Rotalian genus *Cycloloculina.* A reference to that paper will demonstrate to the Rhizopodist of what extraordinarily diversified materials the shore-sands of Selsey Bill are composed, and it will cease to be surprising under the circumstances that so wide a range of Foraminifera should be discoverable in them, both as regards number of genera and of species, and as regards periods of geological time.

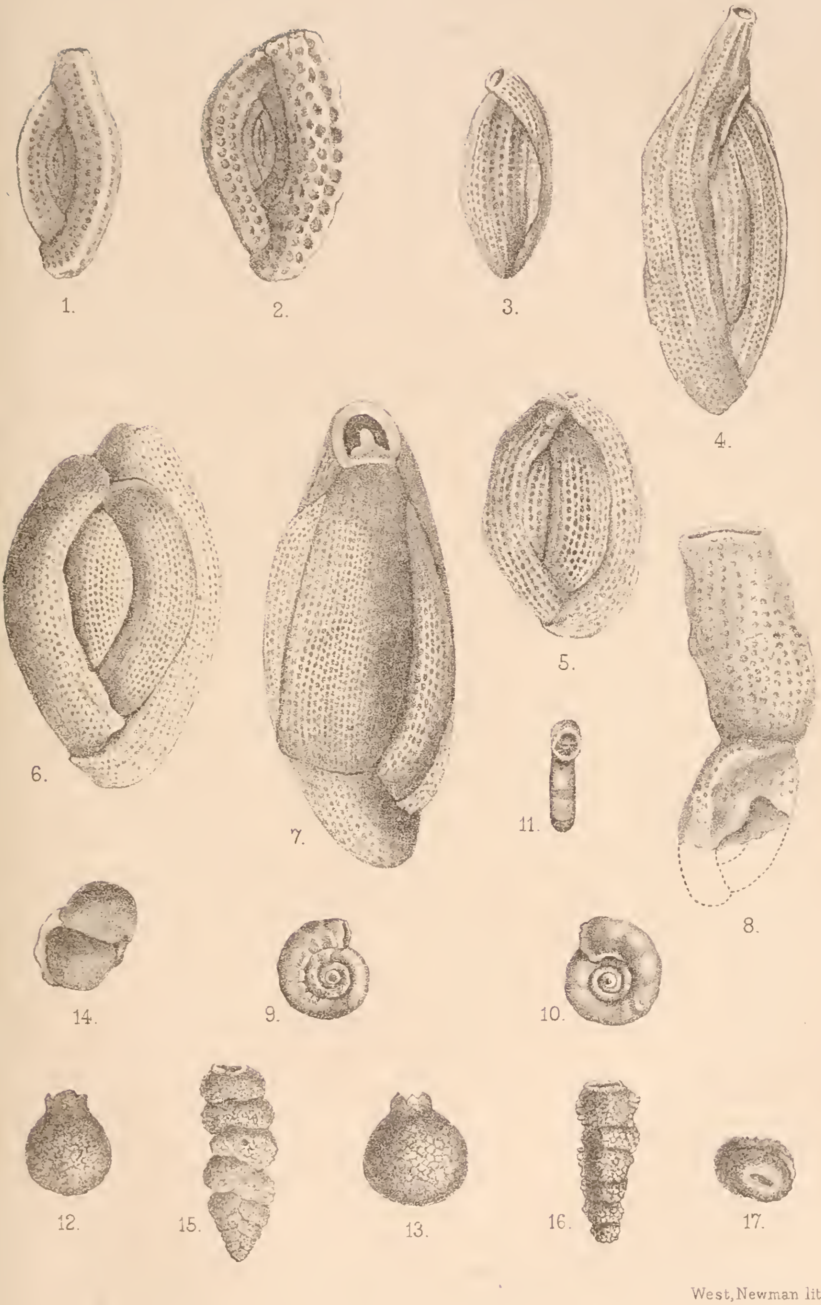
In the foremost place, of course, we find the ordinary shallow-water littoral species in their usual profusion when sought for under favourable conditions, the extremely flat and far-reaching

* The first of this series of papers was published in the Society's Journal, 1908, pp. 529–543, under the title of "On *Cycloloculina*, a New Generic Type of the Foraminifera; with a Preliminary Study of the Foraminiferous Deposits and Shore-sands of Selsey Bill."

EXPLANATION OF PLATE XV.

Fig. 1.—*Spiroloculina pertusa* Terquem.
,, 2.—*S. foveolata* Egger.
,, 3—*Miliolina parisiensis* d'Orbigny, sp.
,, 4.—Ditto.
,, 5.—Ditto.
,, 6.—*Miliolina saxorum* Lamarck, sp.
,, 7.—Ditto.
,, 8.—*Articulina foveolata* sp. n.
,, 9.—*Cornuspira selseyensis* sp. n.
,, 10.—Ditto.
,, 11.—Ditto. Oral aspect.
,, 12.—*Saccammina sphærica* M. Sars.
,, 13.—Ditto.
,, 14.—*Webbina hemisphærica* Jones, Parker, and Brady.
,, 15.—*Bigenerina selseyensis* sp. n.
,, 16.—Ditto.
,, 17.—Ditto. Oral aspect.

All figures magnified 50 diameters.



West, Newman lith

sands of the west shore of the Bill lending themselves with peculiar adaptability as the resting place of the shells between high- and low-water marks. In addition to this we have to bear in mind that the peninsula, which is formed of brick-earth and glacial drift of varying thicknesses, resting upon the western extremity of the old raised beach which extends from Brighton to Havant,* is bedded upon and entirely surrounded by clay reefs ("clibs" as they are locally called) of Lower Eocene date. These are the celebrated Bracklesham beds which extend in a circle, almost like the outer reef of a coral island, from West Wittering and Chichester Harbour on the west, to Pagham on the east, and the various bands of these beds, known as they are by their characteristic fossils as, for instance, the *Turritella* bed, the *Nummulite* bed, the *Cardita* bed, the *Myliobatis* (or Palate) bed and so on, are seen to dip below the peninsula, and to make their reappearance in their regular order upon the other side. Beyond Pagham comes the whole range of the London Clay beds (upon which the Bracklesham beds rest), cropping out upon the shore as the Barn Rocks, and the Bognor Rocks. Beyond Bognor again the Upper Chalk appears on the shore. Thus we have, added to the usual littoral species of Foraminifera, a vast number of fossil species derived from the Bracklesham Beds and the London Clay, of the neighbourhood, whilst the travelling shingle, bringing with it eastward the flints of the Upper Chalk, smashes a due proportion of them, containing cavities once occupied by *Siphonia* and other sponges, but now filled with the casts of Chalk Foraminifera, which disperse upon our shore-sands, and join in the extremely mixed bathing which is enjoyed by the Rhizopodal fauna of our singularly favoured peninsula.

In the Catalogue of Foraminifera which mainly constitutes this and the succeeding papers of our series, little or no attempt is made to describe the particular species from any particular gathering at any precisely noted spot upon the shores of Selsey Bill. This is for two or three reasons; first, that the main body of shells described came from a large mixed gathering of 1000 c.c. taken during a series of walks of two and a half miles from the extreme point of the Bill, eastwards, up to Thorney Farm in Bracklesham Bay; second, that for ordinary purposes of study this may fairly be taken to be one locality; and, third, it was not until we began seriously to search for the source of origin of the genus *Cycloloculina* that we began to make strictly localised gatherings at distances from about a quarter to half a mile apart round the peninsula. When, therefore, in the notes that accompany the catalogue of species, no precise locality is mentioned, it may be taken to have been picked out of the 1000 c.c. above referred to.

A certain number of the fossil forms now described will be found

* Bibliography (1908), p. 542, No. II.

to be referred to the Chalk, but a more systematic examination and description of the Chalk Foraminifera to be found in these sands, is reserved for a future and special paper of their own in this series.

Before beginning the Catalogue we may perhaps be allowed to call attention to certain idiosyncrasies of these sands. Foremost among these, of course, is the fact that highly varying forms of the same species are to be found together at all points of the shore. Next, that besides the new genus *Cycloloculina* in its two species *annulata* and *polygyra*, there are to be found in these sands a notable number of species among the recent forms that are entirely new to the student of the Foraminifera, whilst some forms are recorded as fossils that have never before been found excepting in recent gatherings, and, we may probably say, *vice versâ*. Lastly, the shore-sands furnish specimens of some few species that one would never expect to find in a littoral gathering at all; forms having been encountered whose hitherto recognised habitat has been the profundities of great oceans, whilst others are of species hitherto regarded as brackish water, or estuarine, species.

The shore-sands of the British Islands have not hitherto received that systematic attention from Rhizopodists to which their interest entitles them, but in connection with the deposits now under consideration we may mention that a short list of the Foraminifera of this district was contributed by Mr. F. W. Millett, F.R.M.S., to Mr. Alfred Bell's paper "Notes on a Post-Tertiary Deposit in Sussex" in the Yorkshire Philosophical Society's Report, 1892. This list was subsequently supplemented by a privately circulated note issued by Mr. Millett, entitled "The Foraminifera of a Post-Tertiary Deposit in Sussex," from which we learn that the material examined consisted of about three ounces of coarse sand, and at the end of which the author remarks: "It is evident that the deposit contains Foraminifera derived from the Eocene, and possibly from the Cretaceous, formations, mixed with a large number of recent specimens, the remainder being composed of Tertiary forms, to which, under the circumstances, it would be difficult to assign the exact horizon. Some of the species are represented by specimens both recent and fossil. This note, necessary to explain the incongruous concourse of species, was omitted from Mr. Bell's communication to the Society."

The appended list contained fifty-six species, of which in the subjoined catalogue will be found all but four, which will, no doubt, come to light at an early date.

It is the circumstances recorded in this brief introduction which have led, and encouraged, us to take the district very seriously, and to devote to the examination of its shore-sands an amount of close attention which, we trust, Rhizopodists will agree with us, has not been unworthily or unprofitably applied.

Sub-Kingdom **PROTOZOA.**

Class RHIZOPODA.

Order *FORAMINIFERA.*

Family II. MILIOLIDÆ..

Sub-family 1. **Nubecularinæ.**

Nubecularia Defrance.

1. *Nubecularia lucifuga* Defrance.

Nubecularia lucifuga Defrance, 1825, Dict. Sci. Nat., vol. xxv. p. 120; Atlas Zooph., pl. xliv. fig. 3.
Ditto. (Defrance) Brady, 1884, Forams. 'Challenger,' p. 134, pl. i. figs. 9–16.
Ditto. (Defrance) Brady, 1887, Synopsis of British Recent Foraminifera.
Ditto. (Defrance) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 191, pl. xi. figs. 1–3, and pl. xiv. fig. 2.
Ditto. (Defrance) Sidebottom, 1904, Mem. and Proc. Manchester Lit. and Phil. Soc., vol. xlviii. No. 5, p. 2, pl. ii. figs. 1–4.

Frequent, both recent and fossil. The fossil specimens are of the massive labyrinthic type, whereas the recent ones are of the depressed encrusting type. Some of the recent specimens show the regular truncatuline arrangement of the chambers figured by Sidebottom from the Delos specimens.

Recorded by Millett—rare.

Sub-Family 2. **Miliolininae.**

Biloculina d'Orbigny.

2. *Biloculina ringens* Lamark sp.

Miliolites ringens Lamarck, 1804, Ann. du Muséum, vol. v. p. 351, No. 1, vol. ix. pl. xvii. fig. 1.
Biloculina ringens (Lamarck) Brady, 1884, Foram. 'Challenger,' p. 142, pl. ii. figs. 7, 8.
Ditto. (Lamarck) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil only. The specimens are apparently derived from at least two different deposits, probably a clay and a shell sand.

Millett's record, "very common."

3. *Biloculina sphæra* d'Orbigny.

Biloculina sphæra d'Orbigny, 1839, Foram. Amér. Mérid., p. 66, pl. viii. figs. 13-16.
Biloculina sphæra (d'Orbigny) Brady, 1864, Trans. Linn. Soc. Lond., vol. xxiv. p. 466, pl. xlviii. fig. 1 *a*, *b*.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 141, pl. ii. fig. 4 *a*, *b*.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

One small specimen from opposite Thorney Coastguard Station. Apparently a recent specimen, although the form is usually a deep-water type round our coasts.

Spiroloculina d'Orbigny.

4. *Spiroloculina limbata* d'Orbigny.

Spiroloculina limbata d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 299, No. 12.
Ditto. Bornemann, 1855, Zeitschr. deutsch. geol. Gesell., vol. vii. p. 348, pl. xix. fig. 1.
Spiroloculina depressa (d'Orbigny) Williamson, 1858, Rec. Foram. Gt. Britain, p. 82, pl. vii. fig. 177.
Spiroloculina limbata (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 150, pl. ix. figs. 15–17.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil and recent. The fossil specimens are from at least two different deposits—a clay with pyritic infiltrations, and probably a clean shell sand.

5. *Spiroloculina excavata* d'Orbigny.

Spiroloculina excavata d'Orbigny, 1846, Foram. Foss. Vienne, p. 271, pl. xvi. figs. 19–21.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 151, pl. ix. figs. 5, 6.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil only. The specimens are well developed and typical, some of them showing signs of pyritic internal casts, which points to a clay as their source of origin.

6. *Spiroloculina incerta* Terquem.

Spiroloculina incerta Terquem, 1882, Mém. Soc. Géol. France, ser. 3, vol. ii. Mém. III. p. 161, pl. xvi. figs. 29 *a*, *b*.

Fossil only. Terquem's description agrees very well with our specimens. Only the last two chambers are visible, the earlier ones being concealed by a deposit of shell-substance. The aperture, which is upon a produced phialine neck, is very characteristic.

7. *Spiroloculina tenuis* Czjzek sp.

Quinqueloculina tenuis Czjzek, 1847, Haidinger's Naturw. Abhandl., vol. ii. p. 149, pl. xiii. figs. 31–34.
Spiroloculina tenuis (Czjzek) Brady, 1884, Foram. 'Challenger,' p. 152, pl. x. figs. 7–11.
Miliolina tenuis (Czjzek) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil only. This species has already been recorded from Tertiary deposits by Czjzek, Reuss, and Karrer.

Recorded by Millett, "very rare."

8. *Spiroloculina tenuiseptata* Brady.

Spiroloculina tenuiseptata Brady, 1884, Foram. 'Challenger,' p. 153, pl. x. figs. 5, 6.
Ditto. (Brady) Egger, 1893, Abhandl. d. k. bayer. Akad. d. Wiss., Cl. II. vol. xviii. p. 223, pl. i. figs. 48, 49.
Ditto. (Brady) Millett, 1898, Malay Forams., Journ. R. Micr. Soc. p. 265.

The specimens are undoubtedly fossils and apparently derived from a clay. Brady's specimens are all from tropical or subtropical localities, and so far as we are aware the species has not previously been recorded in the fossil state.

9. *Spiroloculina grata* Terquem.

Spiroloculina grata Terquem, 1878, Mém. Soc. Géol. France, ser. 3, vol. i. p. 55, pl. x. figs. 14*a*–15*b*.
Ditto. (Terquem) Brady, 1884, Foram. 'Challenger,' p. 155, pl. x. figs. 16, 17, 22, 23.
Spiroloculina nitida (d'Orbigny), (striate variety) Millett, 1898, Malay Forams. Journ. R. Micr. Soc. p. 266.

The specimens observed are all fossil. Terquem's specimens were Tertiary fossils from Rhodes. Its recent habitat is the shallow water of tropical seas.

Recorded by Millett, "very rare."

10. *Spiroloculina foveolata* Egger. Plate XV. fig. 2.

Spiroloculina foveolata Egger, 1893, Abhandl. d. k. bayer. Akad. d. Wiss., Cl. II. vol. xviii. p. 224, pl. i. figs. 33, 34.
Spiroloculina nitida (reticulate variety) (Egger) Millett, 1898, Journ. R. Micr. Soc., p. 266.

One very well preserved fossil. Egger's specimen was from Mauritius and Millett's from the Malay Archipelago. It has apparently never been recorded as a fossil.

11. *Spiroloculina pertusa* Terquem. (Pl. XV. fig. 1).

Spiroloculina pertusa Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii. Mém. III. p. 160, pl. xvi. fig. 27 *a*, *b*.

Fossil. A single specimen only of this pretty form, which agrees in every respect with Terquem's figure.

Miliolina Williamson.

12. *Miliolina seminulum* Linné sp.

Serpula seminulum Linné, 1767, Syst. Nat. 12th ed. p. 1264, No. 791.
Ditto. 1788, 13th (Gmélin's) ed. p. 3739, No. 2.
Miliolina seminulum (Linné) Brady, 1884, Foram. 'Challenger,' p. 157, pl. v. fig. 6 *a*, *b*, *c*.
Ditto. (Linné) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Linné) Goës, 1894, Arctic and Scandinavian Forams., p. 108, pl. xviii. figs. 838–838 *n*, and pl. xix. figs. 840–3.

Fossil and recent. This usually abundant species is poorly represented in these sands in either the fossil or the recent state. Goës (*suprà*) furnishes an extensive series of figures of this species and its allies.

Recorded by Millett, "very common."

13. *Miliolina oblonga* Montagu sp.

Vermiculum oblongum Montagu, 1803, Test. Brit., p. 522, pl. xiv. fig. 9.
Miliolina oblonga (Montagu) Brady, 1884, Foram. 'Challenger,' p. 160, pl. v. fig. 4 *a, b*.
Ditto. (Montagu) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Montagu) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 110, pl. xx. figs. 850–850*f*.

Fossil and recent. The specimens are for the most part typical. Several fossil specimens have also been found intermediate in character between *Miliolina oblonga* and *M. linneana*, the markings being too weak to allow of their being allotted to the latter form.

Recorded by Millett, "common."

14. *Miliolina auberiana* d'Orbigny sp.

Quinqueloculina auberiana d'Orbigny, 1839, Foram. Cuba, p. 157, pl. xii. figs. 1–3.
Miliolina auberiana (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 162, pl. v. figs. 8, 9.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foram., p. 109, pl. xix. figs. 844 *a–d*.

Recent only. Common in these shore-sands, as at Bognor, in the neighbourhood, but not otherwise widely distributed in this country.

15. *Miliolina pygmæa* Reuss sp.

Quinqueloculina pygmæa Reuss, 1850, Denkschr. d. k. Akad. Wien., vol. i. p. 384, pl. i. fig. 3 *a, b*.
Quinqueloculina lucida Karrer, 1868, Sitzungsb. d. k. Akad. Wiss. Wien., vol. lvii. p. 147, pl. ii. fig. 7.
Miliolina pygmæa (Reuss) Brady, 1884, Foram. 'Challenger,' p. 163, pl. cxiii. fig. 16 *a, b*.

Fossil only. From the appearance of the specimens they would appear to have been derived from a clay.

16. *Miliolina trigonula* Lamarck sp.

Miliolites trigonula Lamarck, 1804, Ann. du Muséum, vol. v. p. 351, No. 3.
Ditto. Lamarck, 1822, Anim. sans Vert., vol. vii. p. 612, No. 3.
Miliolina trigonula (Lamarck) Brady, 1884, Foram. 'Challenger,' p. 164, pl. iii. figs. 14–16.
Ditto. (Lamarck) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Lamarck) Goës, 1894, Artic and Scandinavian Foraminifera, p. 115, pl. xxii. fig. 870.

Fossil and recent. The species is of frequent occurrence in the fossil, and abundant in the recent state.

Recorded by Millett, "common."

17. *Miliolina tricarinata* d'Orbigny sp.

Triloculina tricarinata d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 299, No. 7; Modèle No. 94.
Miliolina tricarinata (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 165, pl. iii. fig. 17 *a, b*.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, pp. 114–15, pl. xxi. figs. 866–9.

Fossil and recent. The specimens though small are typical. This species is never of frequent occurrence in shore gatherings, whereas its near ally *M. trigonula* is usually abundant.

Bell records this form in his paper.

18. *Miliolina subrotunda* Montagu sp.

Vermiculum subrotundum Montagu, 1803, Test. Brit., pt. 2, p. 521.
Miliolina subrotunda (Montagu) Brady, 1884, Foram. 'Challenger,' p. 168, pl. v. fig. 10.
Ditto. (Montagu) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Montagu) Goës, 1894, Arctic and Scandinavian Foraminifera, p 109. pl. xix. figs. 846–7 *a–h*.

Recent only. This species exhibits in the specimens found in these sands the usual wide diversities of form. The biloculine, triloculine, and hauerine types are fully represented, the latter being clearly predominant. One specimen presents the feature of being markedly striate, the striæ being in the contrary direction to that usually observable, namely, at right angles to the longitudinal axis of the shell.

Recorded by Millett, "very rare."

19. *Miliolina circularis* Bornemann sp.

Triloculina circularis Bornemann, 1855, Zeitschr. d. deutsch. geol. Gesell., vol. vii. p. 349, pl. xix. fig. 4.
Miliolina circularis (Bornemann) Brady, 1884, Foram. 'Challenger,' p. 169, pl. iv. figs. 3 *a, b, c*, pl. v. figs. 13, 14 (?).
Ditto. (Bornemann) Millett, 1898, Malay Foram., Journ. R. Micr. Soc., p. 499, pl. xi. figs. 1–3.

Fossil and recent. The fossil specimens are few in number, and from their appearance are probably derived from a clay.

20. *Miliolina bicornis* Walker and Jacob sp.

Serpula bicornis Walker and Jacob, 1798, Adam's Essays, Kanmacher's Edition, p. 633, pl. xiv. fig. 2.
Miliolina bicornis (Walker and Jacob) Williamson, 1858, Recent Foram. Gt. Britain, p. 87, pl. vii. figs. 190–5
Ditto. (Walker and Jacob) Brady, 1884, Foram. 'Challenger,' p. 171, pl. vi. figs. 9, 11, 12.
Ditto. (Walker and Jacob) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Walker and Jacob) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 113, pl. xxi. figs. 860–861 *e*.

Fossil and recent. The specimens exhibit a wide range in the character of their markings, from the most delicately striate to the most coarsely costate types, the latter predominating among the fossil forms.

21. *Miliolina scrobiculata* Brady.

Miliolina scrobiculata Brady, 1884, Foram. 'Challenger,' p. 173, pl. cxiii. fig. 15 *a*, *b*, *c*.

Fossil only. Quite a number of small specimens have been observed which agree very clearly with Brady's description and figure. Brady's specimens were from shore-sand at Madagascar and Nares Harbour (Admiralty Islands) in seventeen fathoms, and there appears to be no other record either recent or fossil, but Brady admits that his form is probably only a local variety of *M. bicornis*, and as such it might be expected to occur wherever *M. bicornis* is abundant.

22. *Miliolina pulchella* d'Orbigny sp.

Quinqueloculina pulchella d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 303, No. 42.
Ditto. (d'Orbigny) Parker, Jones, and Brady, 1871, Ann. and Mag. Nat. Hist., ser. 4, vol. viii. p. 250, pl. viii. fig. 19.
Miliolina pulchella (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 174, pl. vi. figs. 13, 14, pl. iii. figs. 10–13.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

One fine recent specimen, from opposite West Street.

23. *Miliolina linneana* d'Orbigny sp.

Triloculina linneiana d'Orbigny, 1839, Foram. Cuba, p. 172, pl. ix. figs. 11–13.
Quinqueloculina josephina d'Orbigny, 1846, Foram. Foss. Vienne, p. 297, pl. xix. figs. 25–27.
Ditto. (d'Orbigny) Costa, 1856, Atti del Accad. Pont., vol. vii. p. 321, pl. xxv. fig. 4.
Miliolina linnæana (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 174, pl. vi. figs. 15–20.
Ditto. (d'Orbigny) Chapman, 1907, Journ. Linn. Soc., Zoology, vol. xxx. May 1907, p. 20, pl. ii. fig. 37.

Fossil only. The specimens exhibit a marked discrepancy in size, the majority being very small. This probably indicates a different source of origin. The species has been recently recorded as a Tertiary fossil by F. Chapman, and according to Brady the geological range of the species extends back to the Miocene beds of the Vienna basin.

24. *Miliolina ferussacii* d'Orbigny sp.

Quinqueloculina ferussacii d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 301, No. 18; Modèle No. 32.
Miliolina ferussacii (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 175, pl. cxiii. fig. 17*a*, *b*.
Ditto. (d'Orbigny) var. Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. p. 325, pl. xii. figs. 10–12.

Miliolina ferussacii (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Millett, 1898, Malay Foram., Journ. R. Micr. Soc., p. 507, pl. xii. figs. 6, 7.

Fossil only. Some of the specimens closely resemble Brady's figure, but others are very like the figure of *Quinqueloculina stelligera* Schlumberger. We have not, however, seen any specimens of Schlumberger's type with which to compare them.

25. *Miliolina Parisiensis* d'Orbigny sp. Plate XV. figs. 3, 4, 5.

Quinqueloculina Parisiensis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 301, No. 5.
Ditto. (d'Orbigny) Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii. p. 181, pl. xix. fig. 21.
Miliolina Parisiensis (d'Orbigny) Millett, 1898, Journ. R. Micr. Soc., p. 504, pl. xii. figs. 1 *a*, *b*, *c*.

Fossil only. F. W. Millett has furnished an exhaustive bibliography of this species in the paper referred to *suprâ*.

26. *Miliolina saxorum* Lamarck sp. Plate XV. figs. 6, 7.

Miliolites saxorum Lamarck, 1804, Ann. Mus., vol. v. p. 352, No. 5, and vol. xix. (1807) pl. 17, fig. 2 *a*, *b*.
Miliolina saxorum (Lamarck) Defrance, 1824, Dict. Sci. Nat., vol. xxxi. p. 69; vol. xxxii. (1824) p. 176; Atlas Conchol., pl. xv. fig. 1.
Quinqueloculina saxorum (Lamarck) d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 301, No. 1, pl. xvi. figs. 10–14; Modèle No. 33.
Ditto. (Lamarck) Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii. p. 181, pl. xix. fig. 22 *a*, *b*.

Fossil only. The specimens which we have referred to this species are of a flattened contour. The species differs from *M. Parisiensis* in that the pits in that species are intercostal, whereas in *M. saxorum* they are distributed in parallel lines upon the surface of a smooth shell.

Millett's record, "common."

27. *Miliolina contorta* d'Orbigny sp.

Quinqueloculina contorta d'Orbigny, 1846, Foram. Foss. Vienne, p. 298, pl. xx. figs. 4–6.
Quinqueloculina schlerotica Karrer, 1868, Sitz. k. Ak. Wiss. Wien., vol. lviii. Abth 1, p 152, pl iii. fig. 5
Miliolina contorta (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Halkyard, 1889, Trans. Manchester Micr. Soc., p. 6, pl. i. fig. 4.
Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 111. pl. xx. figs. 851, 852.
Ditto. (d'Orbigny) Sidebottom, 1904, Mem. Manch. Lit. and Phil. Soc., vol. xlviii. No. 5, p. 13, pl. iv. figs. 7–9.
Ditto. (d'Orbigny) Earland, 1905, Journal Quekett Micr. Club, Ser. 2, vol. ix. No. 57, p. 195.

Fossil and recent. All the four types noted in Earland's paper (*suprâ*) are represented in these sands.

28. *Miliolina agglutinans* d'Orbigny sp.

Quinqueloculina agglutinans d'Orbigny, 1839, Foram. Cuba, p. 168, pl. xii. figs. 11–13.
Miliolina agglutinans (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 180, pl. viii. figs. 6, 7.
Ditto. (d'Orbigny) Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. p. 355, pl. xiii. figs. 1–3.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

Recent only. The specimens are of a very fine and even texture.

29. *Miliolina fusca* Brady.

Quinqueloculina fusca Brady, 1870, Ann. Mag. Nat. Hist., ser. 4, vol. vi. p. 286, pl. xi. fig. 2.
Miliolina fusca Brady, 1887, Synopsis British Recent Foraminifera.
Miliolina agglutinans (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 110, pl. xix. figs. 848 *f*, *g*, *h*.
Miliolina fusca (Brady) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol ix. No 57, p. 197.

Recent only. The specimens occur in considerable numbers, as at Bognor. There is a considerable range in form, both spiroloculine, quinqueloculine, and hauerine specimens having been observed.

30. *Miliolina alveoliniformis* Brady.

Miliolina alveoliniformis Brady, 1879, Quart. Journ. Micr. Sci., n.s. vol. xix. p. 54.
Schlumbergerina areniphora Munier-Chalmas, 1882, Bull. Soc. Géol. France, sér. iii. vol. x. p. 425, fig.
Miliolina alveoliniformis (Brady) Brady, 1884, Foram. 'Challenger,' p. 181, pl. viii. figs. 15–20.
Ditto. (Brady) Millett, 1898, Malay Foram., Journ. R. Micr. Soc., p. 510.

Fossil only. A small number of specimens have been obtained from the detritus underlying the Mixon Rocks piled around the base of the Mixon Beacon, which are to all appearance referable to this species. They have no doubt been derived from the breaking down of the *Alveolina* limestone, of which these rocks are mainly formed, and it may be noted that thin sections of the Mixon Rocks exhibit numerous individuals with an arrangement of chambers similar to that in recent specimens of the species. *M. alveoliniformis* has not, so far as we are aware, been recorded in the fossil state, but in the living condition it is essentially a coral-reef type, and may be found in most recent dredgings in which *Alveolina* occurs. Hence its occurrence in an *Alveolina* limestone would not be unexpected.

Sub-genus *Massilina* Schlumberger.

31. *Massilina secans* d'Orbigny sp.

Quinqueloculina secans d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 303, No. 43; Modèle No. 96.
Miliolina secans (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 167, pl. vi figs. 1, 2.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Massilina secans (d'Orbigny) Schlumberger, 1893, Mem Soc. Zool. France, vol. vi. p. 218, w. c. figs. 31–34, and pl. iv. figs. 82, 83.
Miliolina secans (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p 112, pl. xx. figs. 856–856 *g*.

Recent and fossil; the recent specimens occurring in the usual profusion, and the fossil specimens being very few in number.

Millett's record, "rare."

32. *Massilina secans* var. *tenuistriata* Earland.

Massilina secans var. *tenuistriata* Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 198, pl. xi. fig. 5.

A few specimens of this variety have been observed. It was originally recorded from the immediate neighbourhood of Bognor.

Note.—As usually is the case where a species predominates in a shore-gathering to such an extent as does *M. secans* at Selsey and at Bognor, abnormal and monstrous forms are of frequent occurrence. They have, however, no special value, beyond affording an excellent illustration of the extreme possible variability of form, which has fostered the multiplication of specific names to an extent which is, in the opinion of many rhizopodists, to be greatly deplored.

Sub-family 3. **Haueririninae.**

Articulina d'Orbigny.

33. *Articulina foveolata* sp. n. Plate XV. fig. 8.

Test elongate, compressed, spathulate, margin somewhat rounded, sutures slightly constricted. Surface covered with rounded shallow pittings arranged in fairly regular lines.

This may be regarded as a close ally of *Articulina lineata* Brady from which it differs principally in the nature of its surface markings.

One specimen only, a fossil, somewhat imperfect. Length of fragment 0·850 mm. Breadth 0·3 mm.

34. *Articulina sulcata* Reuss.

Articulina sulcata Reuss, 1849, Denkschr. d. k. Akad. Wiss. Wien, vol. i. p. 383, pl. xlix. figs. 13–17.
Vertebralina contracta Terquem, 1882, Mém. Soc. Géol. France, ser. 3, vol. ii. Mém. III. p. 45, pl. ii. figs. 19, 20 (perhaps 21, 22).
Articulina sulcata (Reuss) Brady, 1884, Foram. 'Challenger,' p. 183, pl. xii. figs. 12, 13.

Fossil only. One specimen only from the clay above the "Selsey Beds" opposite West Street. Terquem's species (*suprà*) appears to be the same as Reuss's. He regards figs. 21 and 22 as being young specimens of figs. 19 and 20. Reuss's specimens were figured from the Tertiary beds of Transylvania (Hungary).

Millett's record, "very rare."

Sub-family 4. **Peneroplidinae.**

Cornuspira Schulze.

35. *Cornuspira foliacea* Philippi sp.

Orbis foliaceus Philippi, 1844, Enum. Moll. Sicil., vol. ii. p. 147, pl. xxiv. fig. 26.
Spirillina foliacea (Philippi) Williamson, 1858, Rec. Foram. Gt. Britain, p. 91, pl. vii. fig. 199–201.
Cornuspira foliacea (Philippi) Brady, 1884, Foram. 'Challenger,' p. 199, pl. xi figs. 5–9.
Cornuspira foliacea (Philippi) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil. One large thick-shelled specimen only, approaching the type of *Cornuspira carinata* (Costa) sp.

Bell records this form in his paper on the authority of Chapman.

36. *Cornuspira involvens* Reuss.

Operculina involvens Reuss, 1849, Denkschr. d. k. Akad. Wiss. Wien, vol. i. p. 370, pl. xlv. fig. 20.
Cornuspira involvens (Reuss) Jones, Parker, and Brady, 1866, Monogr. Foram. Crag. (Palæontolog. Soc.) p. 3, pl. iii. figs. 52–4.
Ditto. (Reuss) Brady, 1884, Foram. 'Challenger,' p. 200, pl. xi. figs. 1–3.
Ditto. (Reuss) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Reuss) Rupert Jones, 1895, Monogr. Foram. Crag. (Palæont. Soc.) p. 128, pl. iii. figs. 52–4, woodcuts 11 *a*, *b*.
Ditto. (Reuss) Chapman, 1907, Journ. Linn. Soc., Zoology, vol. xxx. (May) p. 23, pl. ii. fig. 46.

Fossil. The specimens are apparently derived from a clay, being filled for the most part with pyrites.

37. *Cornuspira selseyensis* sp. n. Plate XV. figs. 9, 10, 11.

Cornuspira ? sp. Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 199, pl. xiii. figs. 2–4.

Recent. The form figured by Earland (*suprà*), occurs fairly frequently both at Bognor and Selsey, and also occurs in many of the "Goldseeker" dredgings, made in the North Sea, though never in any marked abundance. As we have little doubt as to its rhizopodal nature, we have thought it desirable, at this stage, to give it a specific name.

Description.—Test, free; bilaterally complanate, consisting of a conical tube coiled upon itself in one plane, the width of the tube approximately doubling at each convolution. Primordial chamber, large, the number of convolutions usually three and rarely exceeding five. Shell substance, thin, often semi-translucent. Frequently marked with corrugations, which apparently indicate periods of rest in the growth of the shell.

This form may eventually prove to be merely a megalospheric type of *C. involvens* (Reuss).

Peneroplis Montfort.

38. *Peneroplis pertusus* Forskal sp.

Nautilus pertusus Forskal, 1775, Descr. Anim., p. 125, No. 65.
Nautilus planatus var. *a* Fichtel and Moll, 1803, Test. Micr., p. 91, pl. xvi. *a, b, c*.
Dendritina elegans d'Orbigny, 1846, Foram. Foss. Vienne, p. 135, pl. vii. figs. 5, 6.
Ditto. (d'Orbigny) Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii. p. 51, pl. iii. fig. 1 *a, b*.
Peneroplis pertusus (Forskal) Brady, 1884, Forams. 'Challenger,' p. 204, pl. xiii. figs. 16, 17.

Fossil only. One specimen only, small.

39. *Peneroplis pertusus* var. *arietinus* Batsch.

Nautilus umbilicatus Linné, 1767, Syst. Nat., 12th ed. p. 1163, 278.
Nautilus semilituus Linné, 1767, Syst. Nat., 12th ed. p. 1163, 280.
Nautilus (*Lituus*) *arietinus* (pars) Batsch, 1791, Conch. Seesandes, p. 4, pl. vi. fig. 15 *c*.
Peneroplis planatus d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 285, No. 1; Modèle No. 48.
Peneroplis petusus (Forskal) Brady, 1884, Foram. 'Challenger,' p. 204, pl. xiii. figs. 18, 19, 22.

Fossil only. One specimen, small.

40. *Peneroplis pertusus* var. *cylindraceus* Lamarck.

Nautilus (Lituus) arietinus (pars) Batsch, 1791, Conch. Seesandes, p. 4, pl. vi. fig. 15 *d, e, f*.
Spirolina (Spirolinites) cylindracea Lamarck, 1804, Ann. du Muséum, vol. v. p. 245, No. 2.
Spirolina cylindracea (Lamarck) d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 286, No. 1; Modèle No. 24.
Spirolina austriaca d'Orbigny, 1846, Foram. Foss. Vienne, p. 137, pl. vii. figs. 7–9.
Peneroplis pertusus (Forskal) Brady, 1884, Foram. 'Challenger,' p. 205, pl. xiii. figs. 20, 21.

Fossil only. Numerous fragments, a few typical specimens.

41. *Peneroplis pertusus* var. *carinatus* d'Orbigny.

Peneroplis carinatus d'Orbigny, 1839, Foram. Amér. Mérid., p. 33, pl. iii. figs. 7, 8.
Peneroplis dubius d'Orbigny, 1839, Foram. Cuba, p. 79, pl. vi. figs. 21, 22.
Peneroplis pertusus (Forskal) Brady, 1884, Foram. 'Challenger,' p. 205, pl. xiii. fig. 14.

Fossil only, one small specimen.

Note.—The specimens of *Peneroplis* are, with few exceptions, much worn and broken. They closely resemble in appearance the specimens figured by Terquem in his Memoir on the Foraminifera of the Eocene of the Paris Basin, and have doubtless been derived from shell sands of similar age. All the specimens (except perhaps those of *var. cylindraceus*), are of small size compared with those found in recent sub-tropical gatherings.

Millett's record, "common."

Orbitolites Lamarck.

42. *Orbitolites duplex* Carpenter (*macropora* Ehrenberg sp. ?)

Orbulites macropora (?) Lamarck, 1816, Anim. Sans Vert., vol. ii. p. 197, No. 5 (*fide* Carpenter).
Orbitolites macropora (?) Goldfuss, 1826, Petrefacta Germaniæ, etc., vol. i. p. 41, pl. xii, fig. 8 *a, b*.
Orbitolites "duplex type," Carpenter, 1856, Phil. Trans., p. 120, pl. v. fig. 10, pl. ix. fig. 10.
Orbitolites duplex Carpenter, 1883, Report on Genus *Orbitolites*, Zool. 'Challenger' Exp., part xxi. p. 25, pl. iii. figs. 8–14; pl. iv. figs. 6–10; pl. v. figs. 1–13.
Ditto. (Carpenter) Brady, 1884, Foram. 'Challenger,' p. 216, pl. xvi. fig. 7.

Fossil. Fragments only, of frequent occurrence, but owing to the presence of the aperture on many of the fragments it is possible to identify them as belonging to this species. Carpenter supposes the *Orbulites macropora* of Lamarck to be identical with *Orbitolites duplex*, in which case, its geological history will extend back as far as early Tertiary times, otherwise the species is only known in the shallow waters of tropical seas, where it attains a comparatively large size. All our fragments are apparently from individuals of small size.

Sub-family 5. **Alveolininae.**

Alveolina d'Orbigny.

43. *Alveolina boscii* Defrance sp.

Oryzaria boscii Defrance, 1820, Dict. Sci. Nat. vol. xvi. p. 104.
Alveolina boscii (Defrance) d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 306, No. 5; Modèle No. 50.
Alveolina elongata d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 307, No. 6.
Alveolina quoii d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 307, No. 7.
Alveolina boscii (d'Orbigny) Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii. p. 50, pl. ii. fig. 30.
Ditto. (Defrance) Brady, 1884, Foram. 'Challenger,' p. 222, pl. xvii. figs. 7–12.

Fossil. One of the chief constituents of the Mixon Rocks, from which detached specimens occur in profusion in the coarser siftings from all the gatherings. The specimens exhibit great diversity of form, ranging from *Alveolina sabulosa* (Montfort) to the slender *A. quoii* (d'Orbigny), and some of them even approach *A. melo* (Fichtel and Moll). We have, however, recorded them all under Defrance's species, as a more convenient method of dealing with the genus as represented in these shore-sands.

Millett's record includes *A. sabulosa* (Montfort), "very common."

Family III. ASTRORHIZIDÆ.

Sub-family 3. **Saccammininae.**

Psammosphæra Schulze.

44. *Psammosphæra fusca* Schulze.

Psammosphæra fusca Schulze, 1874, II. Jahresberichte d. Komm. Unters. d. deutsch. Meere in Kiel, p. 113, pl. ii. fig. 8.
Ditto. (Schulze) Brady, 1879, Quart. Journ. Micr. Sci., vol. xix. N.S. p. 27, pl. iv. figs. 1–2.
Ditto. (Schulze) Brady, 1884, Foram. 'Challenger,' p. 249, pl. xviii. figs. 1–8.
Ditto. (Schulze) Brady, 1887, Synopsis British Recent Foraminifera.

Recent. One small but regular and quite typical specimen. The occurrence of this species in our shore-sand is somewhat remarkable, as it is, normally, a deep-sea type. Schulze's original specimens were from a depth of 120 fathoms off the coast of Norway, and it has been recorded from Loch Scavaig, Skye, from a depth of 45 to 60 fathoms. It is of frequent occurrence in the North Sea, in similar depths, and in cold areas, but its known range extends down to 2,800 fathoms. It has not apparently been hitherto recorded from a shore-sand.

Saccammina M. Sars.

45. *Saccammina sphærica* M. Sars. Plate XV. figs. 12, 13.

Saccamina sphærica M. Sars, 1868, Vidensk.-Selsk. Forhandl. for 1868, p. 248.
Ditto. (M. Sars) G. O. Sars, 1871, Vidensk.-Selsk. Forhandl. for 1871, p. 250.
Ditto. (M. Sars) Carpenter, 1875, The Microscope, 5th ed. p. 532, fig. 272 *a, b, c.*
Ditto. (M. Sars) Brady, Foram. 'Challenger,' p. 253, pl. xviii. figs. 11–17.

The specimens figured are with considerable doubt assigned to this species. They are apparently fossils.

Family IV. LITUOLIDÆ.

Sub-family I. **Lituolinae.**

Reophax Montfort.

46. *Reophax moniliforme* Siddall.

Lituola findens Parker, 1870 (in Dawson's paper), Canad. Nat., vol. v. N.S. p. 177; p. 180, fig 1.
Ditto. (Parker) Siddall, 1878, Proc. Chester Soc. Nat. Sci., pt. ii. p. 47.
Reophax (?) sp. Balkwill and Wright, 1885, Trans. R. Irish Acad., xxviii. (Science) p. 328, pl. xiii. figs. 9 and 22, 23.
Reophax moniliforme Siddall, 1886, Proc. Lit. Phil. Soc. Liverpool, vol. xl. Appendix, p. 54, pl. i. fig. 2.
Reophax findens (Parker) Brady, 1887, Synopsis British Recent Foraminifera.
Reophax sp. (?) (Balkwill and Wright) Halkyard, 1889, Recent Foraminifera of Jersey in Trans. of Manchester Micr. Soc., pl. i. figs. 8, 9.

Recent. Several specimens, all imperfect, as is almost invariably the case. Various writers, including Brady, have attributed these to *R. findens* (Dawson), but in our opinion incorrectly. We have typical specimens of *R. findens*, in which the texture of the shell differs entirely from the characteristic ochraceous brown of *R. moniliforme.* Joseph Wright and others have considered the absence of primordial chambers to be evidence that the organism was of a sessile nature, but from specimens recently dredged by Earland in the Moray Firth, this appears not to be the case; the perfect test being cylindrical in form with a somewhat swollen primordial chamber.

Haplophragmium Reuss.

47. *Haplophragmium agglutinans* d'Orbigny sp.

Spirolina agglutinans d'Orbigny, 1846, Foram. Foss. Vienne, p. 137, pl. vii. figs. 10–12.
Haplophragmium agglutinans (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 301, pl. xxxii. figs. 19–26.
Ditto. (d'Orbigny) Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. (Science) p. 330, pl. xiii. figs. 18–20.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Millett, 1899, Journ. R. Micr. Soc., p. 357, pl. v. fig. 1.

Fossil (?) and recent. Two distinct varieties are observable. One built up of the ordinary constituent of sand grains, the other utilising garnet and magnetite grains.

Millett's record, "rare."

48. *Haplophragmium canariense* d'Orbigny sp.

Nonionina canariensis d'Orbigny, 1839, Foram. Canaries, p. 128, pl. ii. figs. 33, 34.
Nonionina jeffreysii Williamson, 1858, Recent Foram. Gt. Britain, p. 34, pl. iii. figs. 72, 73.
Haphlophragmium canariense (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 310, pl. xxxv. figs. 1–5.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 20, pl. v. figs. 92–101.

Recent. All the specimens are of the compressed evolute type, neatly built of very minute sand grains with a maximum of cement. In most of the specimens the cement is ferruginous, but in some, it is nearly pure white.

49. *Haplophragmium neocomianum* Chapman.

Haplophragmium neocomianum Chapman, 1894, Quart. Journ. Geol. Soc., vol. l. p. 695. pl. xxiv. figs. 2 *a*, *b*.
Ditto. (Chapman) Chapman, 1895, Ann. Mag. Nat. Hist., ser. 6, vol. xvi. p. 315, pl. xi. fig. 7.
Ditto. (Chapman) Chapman, 1900, Journ. Linn. Soc. (Zool.) vol. xxviii. p. 29, pl. v. fig. 2.
Ditto. (Chapman) Chapman, 1904, Proc. Roy. Soc. Victoria, N.S. vol. xvi. part 2, p. 186, pl. xxii. fig. 1.

Fossil. The septation of this species is very obscure, but becomes apparent upon wetting the shell. This species is unknown save in the fossil state, but according to Chapman, it is a frequent constituent of mesozoic microzoa and has been found in the Rhœtic beds of Somerset and the Neocomian beds of Dorset. He has also recorded it from the Cretaceous of South Africa, and from the Jurassic (Lower Oolite) of Geraldton (W. Australia).

Sub-family 2. **Trochammininae.**

Thurammina Brady.

50. *Thurammina papillata* Brady.

"*Orbuline Lituola*" Carpenter, 1875, The Microscope, 5th ed., p. 533, fig. 273, *g*, *h*.
Thurammina papillata Brady, 1879, Quart. Journ. Micr. Sci., xix., N.S. p. 45, pl. v. figs. 4–8.
Ditto. Brady, 1884, Foram. 'Challenger,' p. 321, pl. xxxvi. figs. 7–18.
Ditto. Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Brady) Earland, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 201, pl. xi. figs. 6, 7; xiv. figs. 1, 3.

The curious form figured and described by Earland (*supra*) under the name *Thurammina papillata* Brady, is extremely rare at Selsey, one specimen only being recorded. Nothing further has, therefore, been ascertained as to the true relationship of the form since the Bognor specimens were described. It is not improbable that, when further opportunities have been afforded for the examination of this test, it may be referred to another genus, possibly to a genus hitherto undescribed, as the examination of specimens from a series of typical tests of *Thurammina papillata* from the North Sea has thrown no light upon the affinities of the Bognor specimens, recorded under this name, with which ours is identical.

Ammodiscus Reuss.

51. *Ammodiscus gordialis* Jones and Parker sp.

Trochammina squamata gordialis Jones and Parker, 1860, Quart. Journ. Geol. Soc., vol. xvi. p. 304.
Trochammina squamata var. *gordialis* Parker and Jones, 1865, Phil. Trans., vol. clv. p. 408, pl. xv. fig. 32.
Ammodiscus gordialis (Jones and Parker) Brady, 1884, Foram. 'Challenger,' p. 333, pl. xxxviii. figs. 7–9.
Ditto. (Jones and Parker) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Jones and Parker) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 202.

Recent. The specimens are quite characteristic and exactly similar to those recorded from Bognor. Many of them show signs of having been attached in life to other organisms.

52. *Ammodiscus incertus* d'Orbigny sp.

Operculina incerta d'Orbigny, 1839, De la Sagra's Hist. Physiq. etc., Cuba, "Foraminifères," p. 49, pl. vi. figs. 16, 17.
Spirillina arenacea Williamson, 1858, Rec. For. Gt. Britain, p. 93, pl. vii. fig. 203.
Trochammina incerta (d'Orbigny) Goës, 1882, Kong. Svenska. Vet. Akad. Handling, Band 19, No. 4, p. 136, pl. xi. figs. 404, 405.
Ammodiscus incertus (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 330, pl. xxxviii. figs. 1–3.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Millett, 1899, Journ. R. Micr. Soc. p. 362.

Fossil only. Apparently from a number of different deposits ranging from the Chalk, upwards, some of them being of comparatively large size.

Trochammina Parker and Jones.

53. *Trochammina inflata* Montagu sp.

Nautilus inflatus Montagu, 1808, Test. Brit., Suppl., p. 81, pl. xviii. fig. 3.
Rotalina inflata (Montagu) Williamson, 1858, Rec. Foram. Gt. Britain, p. 50, pl. iv. figs. 93, 94.
Trochammina inflata (Montagu) Brady, 1884, Foram. 'Challenger,' p. 338, pl. xli. fig. 4 *a–c*.
Ditto. (Montagu) Balkwill and Wright, 1885, Trans. R. Irish Acad. (Science), vol. xxviii. p. 331, pl. xiii. figs. 11, 12.

Trochammina inflata (Montagu) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Montagu) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 29, pl. vi. figs. 222–4.
Ditto. (Montagu) Earland, 1905, Journ. Quekett Micr. Soc., ser. 2, vol. ix. No. 57, p. 203.

Recent. If, as Brady supposes, this is essentially an estuarine species, the extensive mud-flats of Bosham and Chichester Harbour are the probable source of origin of the specimens, which occur in such unusual abundance in the shore-sands of both Bognor and Selsey. It would, however, seem improbable, that, regard being had to the friable nature of the test, specimens of this species should travel such a distance upon a shore so exposed to a recurrence of strong gales. Pending further researches we must consider that Brady's theory as to its essentially estuarine character, remains unproved.

54. *Trochammina squamata* Jones and Parker.

Trochammina squamata Jones and Parker, 1860, Quart. Journ. Geol. Soc., vol. xvi. p. 304.
Ditto. (Jones and Parker) Brady, 1884, Foram. 'Challenger,' p. 337, pl. xli. fig. 3.
Ditto. (Jones and Parker) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Jones and Parker) Egger, 1893, Abhandl. k. bayer Akad. Wiss., Cl. II. vol. xviii. p. 264, pl. v. figs. 4–6.

Recent. One typical specimen. The form is of very rare occurrence in a shore-sand.

Webbina d'Orbigny.

55. *Webbina hemisphærica* Jones, Parker, and Brady. Plate XV. fig. 14.

Webbina hemisphærica Jones, Parker, and Brady, 1866, Monogr. Foram. Crag (Palæontolog. Soc.), p. 27, pl. iv. fig. 5.
Ditto. (Jones, Parker, and Brady) Robertson, 1875, Report Brit. Assoc., Bristol Meeting, p. 189.
Ditto. (Jones, Parker, and Brady) Brady, 1884, Foram. 'Challenger,' p. 350, pl. xli. fig. 11.
Ditto. (Jones, Parker, and Brady) Brady, 1887, Synopsis British Recent Foraminifera.

The specimens figured are with considerable hesitation referred to this species. There is nothing to indicate the age of the specimens, but they are probably recent, as it is hardly conceivable that such a fragile organism could be preserved intact unless in a sheltered angle of its host. The species was originally described from the Crag of Sutton, Suffolk, and has been recorded at rare intervals around our coast. Earland, who has dredged it at several localities off Scotland, has observed a considerable difference in the (1) size, (2) colour, (3) rotundity of the specimens. The Selsey specimens agree with the type in the absence of a "floor" to the chamber. They are attached to quartz grains. The specimen figured has two chambers side by side, but without any means of communication between them.

Family V. TEXTULARIDÆ.

Sub-family 1. Textularinae.

Textularia Defrance.

56. *Textularia agglutinans* d'Orbigny.

Textularia agglutinans d'Orbigny, 1839, Foram. Cuba, p. 136, pl. i. figs. 17, 18, 32, 34.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 363, pl. xliii. figs. 1–3, vars. figs. 4–12.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 35, pl. vii. figs. 281–4, 294–303.

One fairly large fossil specimen, infiltrated with pyrites, from the sands above the Bracklesham Beds, opposite (old) Thorney Coastguard station.

57. *Textularia gramen* d'Orbigny.

Textularia gramen d'Orbigny, 1846, For. Foss. Vienne, p. 248, pl. xv. figs. 4–6.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 365, pl. xliii. figs. 9, 10.
Ditto. (d'Orbigny) Balkwill and Wright, 1885, Trans. R. Irish Acad. vol. xxviii. (Science) p. 332, pl. xiii. figs. 13, 14.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil and recent. Typical.

58. *Textularia globulosa* Ehrenberg.

Textularia globulosa Ehrenberg, 1838, Abhandl. k. Akad. Wiss. Berlin, p. 135, No. 60, pl. iv. fig. β.
Ditto. (Ehrenberg) Reuss. 1845–1846, Verstein. böhm. Kreide, vol. i. p. 39, pl. xii. fig. 23.
Ditto. (Ehrenberg) Eley, 1859, Geology in the Garden, p. 202, pl. ix. fig. 9*c*.
Ditto. (Ehrenberg) Brady, 1870, Ann. Mag. Nat. Hist. ser. 4. vol. vi. p. 300, pl. xii. fig. 4 *a b*.
Ditto. (Ehrenberg) Balkwill and Wright, 1885, Trans. R. Irish Acad. vol. xxviii. (Science) p. 332.
Ditto. (Ehrenberg) Brady, 1887, Synopsis Brit. Rec. Foram.

Fossil. These specimens are evidently derived from the Chalk. It has been recorded in the recent condition by Balkwill and Wright (*suprâ*), "off Dublin—very rare."

59. *Verneuilina elongata* Terquem.

Verneuilina elongata Terquem, 1882, Mém. Soc. Géol. France, ser. 3, vol. ii. Mém. III. p. 106, pl. xi. figs. 13 *a*, *b*, *c*.

Fossil. One specimen, agreeing in all essentials with Terquem's description and figures. He remarks that the arrangement of the chambers is identical with that of *Tritaxia tricarinata* (Reuss), with which it may perhaps be considered as isomorphous.

60. *Verneuilina polystropha* Reuss sp.

Bulimina polystropha Reuss, 1845, Verstein. böhm. Kreid., pt. ii. p. 109, pl. xxiv. fig. 53.
Bulimina scabra Williamson, 1858, Recent Foram. Gt. Britain, p. 65, pl. v. figs. 136, 137.
Bulimina arenacea. Ibid., p. 98.
Verneuilina polystropha (Reuss) Brady, 1884, Foram. 'Challenger,' p. 386, pl. xlvii. figs. 15–17.
Ditto. (Reuss) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Reuss) Goës, 1894, Arctic and Scandinavian Foram., p. 32, pl. vii. figs. 247–55.

Fossil (?) and recent. All the specimens are of the large, smoothly built, regular type, but they fall naturally into two distinct and well marked groups, one of a rich ferruginous brown, due to the character of the cement with which the sand-grains are built together; the other, pale grey. The latter group is further characterised by the inclusion of numerous grains of garnet, magnetite, and other minerals, giving them a very handsome appearance. It is permissible to conjecture that these marked differences in appearance are due to differences in the source of origin, and we hope eventually to be able to trace the source from which the pale specimens derive their material, and to ascertain whether they are recent or fossil.

Millett records, "rare."

61. *Verneuilina pygmæa* Egger sp.

Bulimina pygmæa Egger, 1857, Neues Jahrb. für Min., etc., p. 284, pl. xii. figs. 10, 11.
Verneuilina pygmæa (Egger) Parker and Jones, 1863, Ann. and Mag. Nat. Hist., ser. 3, vol. xi. pp. 92, 98.
Textilaria triseriata Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii.; Mém. III. p. 145, pl. xv. fig. 10.
Verneuilina pygmæa (Egger) Brady, 1884, Foram. 'Challenger,' p. 385, pl. xlvii. figs. 4–7.

Fossil. A single and typical specimen, possibly derived from the Chalk.

62. *Verneuilina spinulosa* Reuss.

Verneuilina spinulosa Reuss, 1849, Denkschr. d. k. Akad. Wiss. Wien, vol. i. p. 374, pl. xlvii. fig. 12.
Ditto. (Reuss) Brady, 1870, Ann. and Mag. Nat. Hist., ser. 4, vol. vi. p. 301, pl. xii. fig. 6.
Ditto. (Reuss) Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii.; Mém. III. p. 107, pl. xi. fig. 16, *a. b.*
Ditto. (Reuss) Brady, 1884, Foram. 'Challenger,' p. 384, pl. xlvii. figs. 1–3.
Ditto. (Reuss) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Reuss) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 205.

Fossil. Several specimens, apparently derived from different sources. The species has, however, been recorded as recent from the estuary of the Dee (Siddall), the Dublin coast (Balkwill and Wright), Westport, Ireland (Brady), and Bognor (Earland). In view of the proximity of Bognor to Selsey, we now consider that Earland's recorded specimen should be doubtfully regarded as recent

63. *Verneuilina triquetra* Münster sp.

Textularia triquetra Münster, 1838, Romer, Neues Jahrb. für Min., p. 384, pl. iii. fig. 19.
Verneuilina triquetra (Münster) Parker and Jones, 1863, Ann. and Mag. Nat. Hist., ser. 3, vol. xi. p. 92.
Ditto. (Münster) Brady, 1884, Foram. 'Challenger,' p. 383, pl. xlvii. figs. 18–20.
Ditto. (Münster) Chapman, 1892, Journ. R. Micr. Soc., p. 329, pl. vi. fig. 24.

Fossil. One specimen, apparently derived from the Chalk.

Tritaxia Reuss.

64. *Tritaxia lepida* Brady.

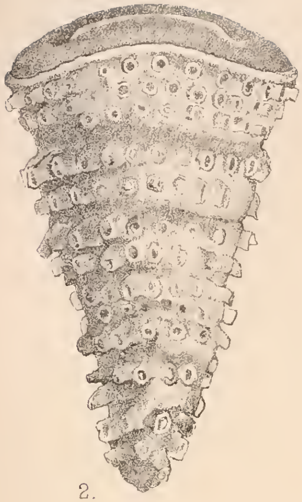
Tritaxia lepida Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. N.S. p. 55.
Tritaxia ovata Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii. Mém. III. p. 105, pl. xi. fig. 11.
Tritaxia lepida (Brady) Brady, 1884, Foram. 'Challenger,' p. 389, pl. xlix. fig. 12 *a*, *b*.
Ditto. (Brady) Millett, 1899, Journ. R. Micr. Soc., p. 12, pl. i. fig. 15.

Fossil. A single specimen from under the rocks at the Mixon Beacon, doubtless derived from the detritus of the *Alveolina* limestone, of which they are mainly composed. The specimen agrees in all essentials with Millett's figure (*suprà*). The species has not previously been recorded as fossil, except by Terquem (*suprà*), from the Eocene of the Paris Basin. The habitat of recent specimens is the shallow waters of tropical shores, hence agreeing very well with the source of origin of our specimen.

65. *Tritaxia tricarinata* Reuss.

Textularia tricarinata Reuss, 1845, Verstein. Böhm. Kreid., pt. i. p. 39, pl. viii. fig. 60.
Verneuilina dubia Reuss, 1850, Haidinger's Naturw. Abhandl., vol. iv. p. 40, pl. iv. fig. 3.
Tritaxia tricarinata Reuss, 1860, Sitzungsb. d. k. Akad. Wiss. Wien, vol. xl. p. 228, pl. xii. figs. 1, 2.
Ditto. (Reuss) Brady, 1884, Foram. 'Challenger,' p. 389, pl. xlix. figs. 8, 9.

Two fossil specimens.



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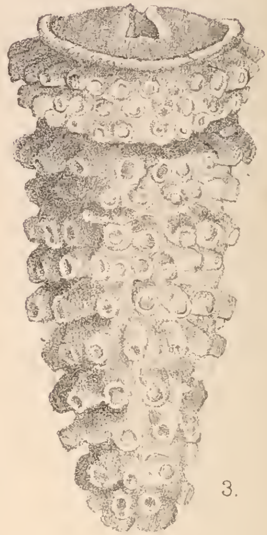

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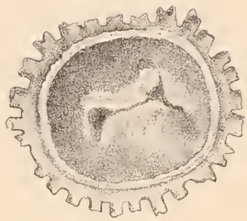

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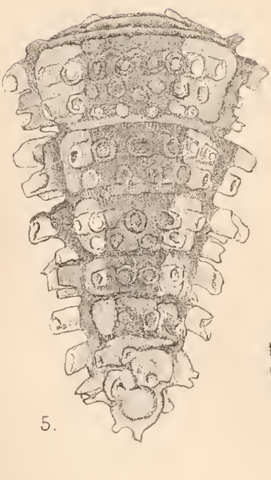

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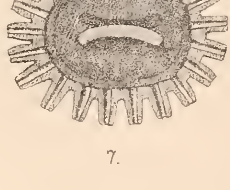

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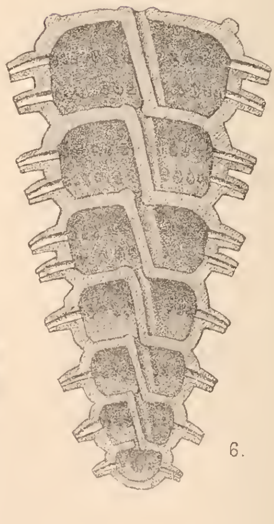


6.

West, Newman lith

Bigenerina d'Orbigny.

66. *Bigenerina conica* sp. n. Plate XVI.

Clavulina cocæna (Gümbel), Terquem, 1882, Mém. Soc. Géol. France, ser. 3, vol. ii. Mém. III. p. 121, pl. xii. fig. 35 *a, b*.

Among the specimens from the shore-sands were found three which presented considerable difficulty in identification. Following Terquem's figures (*suprà*) we were at first inclined to allot them to the species *Clavulina coeæna* (Gümbel), but a reference to Gümbel's original figure and description convinced us that Terquem's identification of his specimen was incorrect, and, as we have been unable to identify the form elsewhere, we now describe it under the above name. The aperture and other characteristics of the shell are such as to show it to be a true *Bigenerina*. Terquem's description is as follows :—" Shell short, nail-shaped (*forme de clou*), conical, very rough, oval in transverse section, truncate in front, obtuse behind, formed of chambers first of all spherical, very small and heaped together. The later ones (6–8) very pronounced and arranged in superimposed rings. Sutures large and deep ; aperture oval. Loc., Vaudancourt. Frequent."

This description agrees in nearly all respects with our specimens, except that the sutural lines, though readily distinguishable, can hardly be described as "pronounced," and the surface rugosities referred to in the description are really blunted or broken spines.

The assignation of this form to *Bigenerina* might not have been so certainly decided upon—in view of the few specimens found in

EXPLANATION OF PLATE XVI.

Bigenerina conica sp. n.

Fig. 1.—A specimen (fossil) from Selsey.
,, 2.—Front view, showing aperture and tubular spines.
,, 3.—Side view.
,, 4.—Oral view.
,, 5.—A front view of balsam-mounted specimen. The dark central portion shows the so-called " siphon," extending from floor to roof in central part of each chamber.
,, 6.—Diagrammatic. Longitudinal median section, showing the nature of the tubular spines and of the so-called " siphon."
,, 7.—Diagrammatic. Horizontal median section through a chamber. The partition, or "siphon," is shown in section in the middle of the cavity, the oral opening leading to the next chamber being darkly outlined above it.

Figures 2, 3, 4, 5 are drawn from Moorabool River specimens.

All figures magnified 110 diameters.

the Selsey shore-sands—but for the fact that the same species occurs with tolerable frequency, and very much better developed, both as regards size and condition, in a fossil deposit which we have from Victoria, Australia (Filter Quarry, Moorabool River), stated to be Miocene. This Filter Quarry deposit is a clean Bryozoan shell-sand rich in Foraminifera. We have prepared sections which show that in addition to the ordinary aperture, the species has a number of supplementary apertures in the form of the conical spines, which form rings round the shell and are tubular throughout. Our sections and balsam-mounted specimens also disclose the fact that the species belongs to the group of *Bigenerinæ* for which the late M. Schlumberger proposed the sub-generic name of *Siphogenerina*. The siphon so-called, however, is not a tube, but merely an internal partition or septum, traversing the central portion of each chamber from floor to roof, and curved in section, corresponding with the external aperture, which, in perfect specimens, is a curved slit, and not an oval, as stated by Terquem.

Length of Selsey specimens, 0·3 mm. Breadth, 0·15 mm.

Filter Quarry specimens: length, 0·5–0·9 mm.; breadth, 0·25–0·4 mm. Average number of chambers in uniserial portion, six.

67. *Bigenerina selseyensis* sp. n. Plate XV. figs. 15–17.

Description.—Test dimorphous, consisting of six to eight chambers arranged on the Textularian plan, followed by two to five chambers in a continuous line. The later chambers oval in section, constricted at the sutures; aperture oval, with slightly bordered and raised rim. Surface very rough, semi-arenaceous; traces of spines observable in some specimens.

Not uncommon in the shore-sands, especially opposite Thorney coastguard station. The specimens, which are all similar in appearance, are apparently derived from a clay source, probably the Selsey Beds of Clement Reid. The species bears a considerable external resemblance to *Bigenerina Schlumbergerii*, Millett, but differs from that form in the character of its test, which is rough and semi-arenaceous, instead of hyaline, and in the absence of definite spines. We have been unable to satisfy ourselves as to the presence of an internal siphon. F. Chapman's figure of *Sagrina calcarata* Berthelin sp.* is not unlike our form in general contour, but possesses a fringe of spines round each of the moniliform chambers, which is absent in *B. selseyensis*.

Length, 0·4–0·55 mm.; breadth, 0·150–0·175 mm.; thickness, 0·125 mm.

* See this Journal, 1898, p. 15, pl. ii. fig. 14, *a*, *b*.

Spiroplecta Ehrenberg.

68. *Spiroplecta sagittula* Defrance sp.

Textularia sagittula Defrance 1824, Dict. Sci. Nat., vol. xxxii. p. 177; vol. liii. p. 344, Atlas Conchol., pl. xiii. fig. 5.
Textularia cuneiformis Williamson, 1858, Rec. Foram. Gt. Britain, p. 75, pl. vi. figs. 158, 159.
Textularia sagittula (Defrance) Brady, 1884, Foram. 'Challenger,' p. 361, pl. xlii. figs. 17, 18.
Ditto. (Defrance) Brady, 1887, Synopsis British Recent Foraminifera.
Spiroplecta sagittula (Defrance) J. Wright, 1891, Proc. R. Irish Acad., ser. 3, vol. i. No. 4, p. 471.
Ditto. (Defrance) J. Wright, 1902, Irish Naturalist, vol. xi. p. 211, pl. iii. figs. A, B, C, D, E.
Spiroplecta wrighti Silvestri, 1903, Atti Accad. Nuovi Lincei, Ann. 56, Sessione 3, p. 59.
Spiroplecta sagittula (Defrance) Chapman, 1907, Journ. Linn. Soc. (Zool.) vol. xxx. p. 27, pl. iii. figs. 58, 59.

Fossil and recent. The specimens vary very greatly in size and in maximum width of shell.

69. *Spiroplecta fusca* Earland.

Spiroplecta fusca Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 204, pl. xii. figs. 1, 2, 3.

Recent. One typical specimen from the sand opposite Medmerry Farm.

Valvulina d'Orbigny.

70. *Valvulina austriaca* d'Orbigny.

Valvulina austriaca d'Orbigny, 1846, Foram. Foss. Vienne, p. 181, pl. xi. figs. 7–8.

Fossil. One specimen, rather waterworn, but apparently referable to this species, which has also been recorded by Mr. Millett from this locality.

71. *Valvulina triangularis* d'Orbigny.

Valvulina triangularis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 270, No. 1; Modèle No. 25.
Ditto. (d'Orbigny) Terquem, 1882, Mém. Soc. Géol. France, Sér. iii. vol. ii. p. 101, pl. xi. fig. 4.

We have a single specimen from the shore-sands which is probably referable to this species, and may possibly be the same form as that referred to in Millett's list under the name *Valvulina triangularis* d'Orbigny, Bulimine form. The aperture, however, in our specimen is unfortunately broken.

Clavulina d'Orbigny.

72. *Clavulina communis* d'Orbigny.

Clavulina communis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 268, No. 4.
Ditto. d'Orbigny, 1846, For. Foss. Vienne. p. 196, pl. xii. figs. 1, 2.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 394, pl. xlviii. figs. 1–13.

Fossil. One fine specimen, and numerous fragments; apparently derived from the London Clay.

73. *Clavulina parisiensis* d'Orbigny.

Clavulina parisiensis d'Orbigny. 1826, Ann. Sci. Nat., vol. vii. p. 268, No. 3; Modèle No. 66.
Valvulina parisiensis (d'Orbigny) Parker, Jones, and Brady, 1865, Ann. and Mag. Nat. Hist., ser. 3, vol. xvi. pp. 29, 35, pl. i. fig. 26.
Clavulina parisiensis (d'Orbigny) Terquem, 1882, Mem. Soc. Géol. France, ser. 3, vol. ii. Mém. III. p. 121, pl. xii. fig. 34 *a*, *b*.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 395, pl. xlviii. figs. 14–18.

Fossil. Many specimens, whose appearance denotes probably at least three different sources of origin; probably the London Clay, and two different sandy deposits.

Bulimina d'Orbigny.

74. *Bulimina aculeata* d'Orbigny.

Bulimina aculeata d'Orbigny, 1826, Ann. Sci. Nat., vol. vii., p. 269, No. 7.
Bulimina pupoides var. *spinulosa* Williamson, 1858, Rec. Foram. Gt. Britain, p. 62, pl. v. fig. 128.
Bulimina aculeata (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 406, pl. li. figs. 7–9.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil and recent. The recent specimen, which is the more noticeable as the species is usually confined to deep water, shows well marked spines.

75. *Bulimina affinis* d'Orbigny.

Bulimina affinis (d'Orbigny) 1839, Foram. Cuba, p. 109, pl. ii. figs. 25, 26.
Bulimina ovulum (Reuss), 1850, Haidinger's Natur. Wiss. Abhandl., vol. iv. p. 38, pl. iv. fig. 9.
Bulimina affinis (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 400, pl. l. fig. 14 *a*, *b*.

Many specimens, all fossil, some, certainly, from the Chalk.

76. *Bulimina brevis* d'Orbigny.

Bulimina brevis d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 270, No. 13.
Ditto. d'Orbigny, 1840, Mém. Soc. Géol. France, sér. i. vol. iv., p. 41, pl. iv. figs. 13–14; facsimile in Science Gossip, London, 1870, p. 156, fig. 147.
Ditto. (d'Orbigny) Chapman, 1892, Journ. R. Micr. Soc. p. 8, pl. xii. fig. 8.

One specimen, fossil, from a clay.

77. *Bulimina elegans* d'Orbigny.

Bulimina elegans d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 270, No. 10, Modèle No. 9.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 398, pl. l. figs. 1–4.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil and recent, the former predominating. Among the specimens are several monstrous forms, due to the fusion of two or more individuals. Such specimens are not uncommon in recent dredgings in which this species abounds.

78. *Bulimina elongata* d'Orbigny.

Bulimina elongata d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 269, No. 9.
Ditto. d'Orbigny, 1846, Foram. Foss. Vienne, p. 187, pl. xi. figs. 19, 20.
Ditto. (d'Orbigny) Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii. Mém. III. p. 109, pl. xi. figs. 22 *a*, *b*, 22.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 401, pl. li. figs. 1, 2.

Fossil, and one or two specimens which are apparently recent. The recorded localities for recent specimens are from moderately deep water.

79. *Bulimina obtusa* d'Orbigny.

Bulimina obtusa d'Orbigny, 1840, Mém. Soc. Géol. France, sér. 1, vol. iv. p. 39, pl. iv. fig. 5, 6; facsimile in Science Gossip, London, 1870, p. 156, fig. 143.
Ditto. (d'Orbigny) Chapman, 1892, Journ. R. Micr. Soc. p. 7, pl. xii. fig. 7 *a*, *b*.

Fossil. One specimen.

80. *Bulimina pupoides* d'Orbigny.

Bulimina pupoides d'Orbigny, 1846, Foram. Foss. Vienne, p. 185, pl. xi. figs. 11, 12.
Ditto. (d'Orbigny) Williamson, 1858, Rec. Foram. Gt. Britain, p. 62, pl. v. figs. 124, 125.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 400, pl. l. fig. 15 *a*, *b*.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

Recent specimens frequent; a few fossils.

81. *Bulimina squamigera* d'Orbigny.

Bulimina squamigera d'Orbigny, 1839, Foram. Canaries, p. 137, pl. i. figs. 22–24.
Ditto. (d'Orbigny) Siddall, 1878, Proc. Chester Soc. Nat. Sci., pl. ii. p. 49.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 207.

Fossil only, with one or two doubtful exceptions. The species is of rare occurrence in recent gatherings round the British coast.

Virgulina d'Orbigny.

82. *Virgulina subsquamosa* Egger.

Virgulina subsquamosa Egger, 1857, Neues Jahrb. für Min., etc.; p. 295, pl. xii. figs. 19–21.
Virgulina tenuis Seguenza, 1862, Atti dell' Accad. Gioenia, vol. xviii. ser. 2, p. 110, pl. ii. figs. 2, 2*a*.
Virgulina subsquamosa (Egger) Brady, 1884, Foram. 'Challenger,' p. 415, pl. lii. figs. 7–11.

One specimen, apparently fossil.

Bolivina d'Orbigny.

83. *Bolivina aenariensis* Costa sp.

Brizalina aenariensis Costa, 1856, Atti dell' Accad. Pont., vol. vii. p. 297. pl. xv. fig. 1, *a*, *b*.
Bolivina costata (d'Orbigny) Siddall, 1878, Proc. Chester Soc. Nat. Science, pt. ii. p. 55.
Bolivina aenariensis (Costa) Brady, 1882, Proc. Roy. Soc. Edinburgh, vol. xi. p. 711—Table.
Ditto. (Costa) Brady, 1884, Foram. 'Challenger,' p. 423, pl. liii. figs. 10–11.
Ditto. (Costa) Siddall, 1886, Proc. Lit. Phil. Soc. Liverpool, vol. xl. Appendix, p. 56.
Ditto. (Costa) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil only; apparently from at least two different sources.

84. *Bolivina beyrichi* Reuss.

Bolivina beyrichi Reuss, 1851, Zeitschr. d. deutsch. geol. Gesell., vol. iii. p. 83, pl. vi. fig. 51.
Ditto. (Reuss) Hantken, 1875, Mittheil. Jahrb. d. k. Ung. geol. Anstalt., vol. iv. p. 64, pl. vii. fig. 11.
Ditto. (Reuss) Terrigi, 1880, Atti dell' Accad. Pont., ann. xxxiii. p. 198, pl. ii. fig. 44.
Ditto. (Reuss) Brady, 1884, Foram. 'Challenger,' p. 422, pl. liii. fig. 1.

Fossil, common. The specimens, which are apparently derived from two or three different sources, show a considerable variation in breadth. None of them exhibit any tendency to the formation of the "wing," which is usually more or less prominent in recent examples.

85. *Bolivina dilatata* Reuss.

Bolivina dilatata Reuss. 1849, Denkschr. d. k. Akad. Wiss. Wien, vol. i. p. 381, pl. xlviii. fig. 15.
Textularia variabilis var. *spathulata* Williamson, 1858, Rec. Foram. Gt. Brit., p. 76, pl. vi. figs. 164, 165.
Bolivina dilatata (Reuss) Brady, 1884, Foram. 'Challenger,' p. 418, pl. lii. figs. 20, 21.
Ditto. (Reuss) Brady, 1887, Synopsis British Recent Foraminifera.

Recent. One large and very fine specimen.

86. *Bolivina lævigata* Williamson sp.

Textularia variabilis var. *lævigata* Williamson, 1858, Recent Foram. Gt. Britain, p. 77, pl. iv. fig. 168.
Bolivina textilarioides Reuss, 1862, Sitzungsb. d. k. Akad. Wiss. Wien., vol. xlvi. p. 81, pl. x. fig. 1.
Ditto. (Reuss) Brady, 1884, Foram. 'Challenger,' p. 419, pl. lii. figs. 23–25.
Ditto. (Reuss) Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. (Science) p. 334.
Bolivina lævigata (Williamson) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil. Our specimens conform to Reuss's figure *B. textilarioides* (*suprà*). Following Balkwill and Wright, and also Brady in his "Synopsis," we have assigned them to *B. lævigata* Williamson, but we are not at all convinced as to the correctness of their identification of these two forms. Williamson's type, which has well-marked peculiarities in its initial chambers, and in the texture of its surface, is of continual recurrence in North Sea and other British dredgings. It presents, in our opinion, features sufficiently marked and distinct from *B. textilarioides* to entitle the latter form to separate specific rank.

87. *Bolivina nobilis* Hantken.

Bolivina nobilis Hantken, 1875 (1876) A magy. kir. földt. int. évkönyve, iv. 56, pl. xv. fig. 4, and Mitth. a. d. Jahrb. k. ungar. geol. Anstalt iv. 1875 (1881) 65, same pl. and fig.
Ditto. (Hantken) Brady, 1884, Foram. 'Challenger,' p. 424, pl. liii. figs. 14, 15.
Ditto. (Hantken) Millett, 1900, Journ. R. Micr. Soc., p. 541, pl. iv. fig. 4.
Ditto. (Hantken) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 209.

Fossil. One large and typical example.

88. *Bolivina plicata* d'Orbigny.

Bolivina plicata d'Orbigny, 1839, Foram. Amér. Mérid., p. 62, pl. viii. figs. 4–7.
Ditto. (d'Orbigny) Brady, 1870, Ann. and Mag. Nat. Hist., ser. 4, vol. vi. p. 302, pl. xii. fig. 7.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Halkyard, 1889, Trans. and Ann. Rep. Manchester Micr Soc., p. 35, pl. i. fig. 13.
Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foram., p. 51, pl. ix. figs. 487, 488.

Recent and perhaps also fossil. The specimens are, in every particular, characteristic.

89. *Bolivina punctata* d'Orbigny.

Bolivina punctata d'Orbigny, 1839, Foram. Amér. Mérid., p. 63, pl. viii. fig. 10–12.
Ditto. (d'Orbigny) Brady, 1864, Trans. Linn. Soc. Lond., vol. xxiv. p. 468, pl. xlviii. fig. 9.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 417, pl. lii. figs. 18, 19.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 49, pl. ix. figs. 475-478, 480.

Fossil, frequent. Large and characteristic. Recorded by Millett, "very rare."

90. *Bolivina decorata* Jones.

Bolivina decorata (Jones MS.) Wright, J. in Cretaceous Foraminifera of Keady Hill, Co. Derry, Proc. Belfast Naturalists' Field Club, Appendix 1885-6, p. 330, pl. xxvii. figs. 7, 8.

Fossil. A few specimens only, evidently cretaceous. This rather striking species is apparently nearly allied to *Bolivina reticulata* Hantken. The description, as given by Wright, is as follows: "Test elongate, compressed, broad at the oral end and tapering to a rounded point at the aboral extremity; surface ornamented with prominent oblong tubercles, which are arranged in oblique rows."

The species is common in the Chalk obtained by Wright from hollow flints at Keady Hill, Co. Derry, and probably elsewhere in similar material.

91. *Bolivina variabilis* Williamson sp.

Textularia variabilis (*typica*) Williamson, 1858, Rec. Foram. Gt. Britain, p. 76, pl. vi figs. 162, 163 (incorrectly numbered 162, 161 on plate).
Ditto. (Williamson) Brady, 1887, Synopsis British Recent Foraminifera.
Bolivina variabilis (Williamson) Chaster, 1892, First Report Southport Soc. Nat. Sci., 1890-1891, pp. 59, 69.

Fossil and recent.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Factors in Artificial Parthenogenesis.‡—Isidor Traube applies his theory of osmotic pressure to cases of artificial parthenogenesis. There is a relation between the surface-tension of various acids and their efficacy as agents in artificial parthenogenesis. Substances like chloroform and benzene, which, according to Loeb, produce a membrane on eggs in sea-water, also lower the surface-tension of water. The salts of fatty acids are less active than the fatty acids themselves, and it is shown that they produce a smaller lowering of surface-tension than the acids. The fundamental factor is the difference in capillary pressure between the surface of the egg and the surrounding aqueous medium.

Degeneration of Ovarian Follicles in White Mice.§—A. Chappellier has studied the fragmentation of ova and the chromatolysis that goes on in the degenerating Graafian follicles. A follicle with two ova is to be distinguished from one in which the degenerating ovum has divided into two (always very unequal) parts. In much disintegrated ova crystals may occur. The production of Graafian follicles goes on continuously; only some reach maturity: the rest degenerate, and the cellular disorganisation is probably not without its influence on the life and function of the ovary.

Function of Corpus Luteum.‖—P. Bouin and P. Ancel, continuing their studies on the rabbit, find evidence that the profound changes which go on in the uterus—preparatory to the fixation of the ovum—are due to the influence of the corpus luteum.

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Biochem. Zeitschr., xvi. (1909) pp. 182–6. See also Journ. Chem. Soc., 1909, p. 325.

§ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 543-5 (9 figs.).

‖ Tom. cit., pp. 505–7.

Spermatozoa of Bats and Lemurs.*—E. Ballowitz describes the spermatozoa of *Pteropus*, which have a large head-cap, of *Microcebus*, *Lemur*, and *Chiromys*. The most interesting general result is the strong resemblance between the spermatozoa of *Chiromys* and those of *Lemur*.

Development of Salivary Glands of Cat.†—R. Metzner finds that all the glands, serous as well as mucous, begin alike. Their terminal parts are always like rounded or elongated berries on the ends of the ducts. Later on, towards the end of the first half of the intra-uterine life, the terminal portions of the mucous glands grow into tubules, which soon become coiled. The terminal portions of the serous glands still keep the berry-like appearance. Even at the stage of homogeneous appearance, some cells of the terminal portions and also of the ducts begin to show secretion granules, which are always of mucin. It is noted that the production of mucus only—on to the first month of post-uterine life—may have something to do with the fact that milk mixed with mucus makes a more delicate coagulum in the stomach than unmixed milk does.

Development of Poison-glands in Anura.‡—Otto Weiss could find only one mode of origin of poison-glands in the skin of Anura, namely, by a direct transformation of differentiated mucus glands. Before the metamorphosis there are only mucus glands, and some of these turn into poison-glands.

Amitosis in Embryonic Tissues of Mammals.§—A. Maximow records the normal occurrence of amitosis in mesenchyme cells in various parts of the embryo rabbit ($11\frac{1}{2}$–$13\frac{1}{2}$ days).

Artificially Induced Albinism of the Skin in Axolotl larvæ.‖—G. Tornier has reared reddish yellow or lemon yellow larvæ from black parents. This partial albinism was brought about by making some of the yolk unuseable—puncturing it so that some water got in and made it take granular form. This comes about more readily when the embryo has a weakness in its plasm, and this again can be effected by scarcity of oxygen. When the eggs are put into solutions of salt, sugar, glycerin, etc. for a short time, part of the yolk may coagulate, and then pale larvæ result.

Development of Skull in Teleosts.¶—J. Nusbaum has studied the development of the occipital region of the skull in the carp. Diverse parts of the first three vertebræ share in making the palæocranium of Teleosteans, the first being entirely assimilated. The centra of the three unite in the basi-occipital; the spinous processes of the three coalesce in the supra-occipital. Even the fourth and fifth vertebræ are implicated, but we cannot do more than indicate the general lines of Nusbaum's embryological analysis.

* Anat. Anzeig., xxxiv. (1909) pp. 275–86 (27 figs.).
† Verh. Nat. Ges. Basel, xx. (1909) pp. 38–54.
‡ Anat. Anzeig., xxxiii. (1908) pp. 124–5.
§ Tom. cit., pp. 89–98 (11 figs.).
‖ SB. Ges. Nat. Freunde Berlin, 1908, pp. 66–7.
¶ Anat. Anzeig., xxxii. (1908) pp. 513–32 (14 figs.).

Expulsion of Eggs in Entelurus æquoreus.*—F. Guitel finds from post-mortem observations that the ova are expelled from the cloaca in two ribbons, about 75 mm. long, and consisting of a single layer of 3–5 rows. These ribbons are afterwards fixed to the abdomen of the male in precisely the same position as they had in the ovaries. There is a slight median keel along the abdomen.

Inheritance of Eye-colour in Man.†—C. C. Hurst has studied the eye-colours of a number of parents and their offspring in a Leicestershire village, and finds that there are at least two discontinuous types of iris in man. There is the duplex type, with both anterior and posterior pigments, as in ordinary brown eyes, and there is the simplex type, with posterior pigment only, the anterior pigment being absent, as in clear blue eyes. The simplex type behaves as a Mendelian recessive to the duplex type, which is dominant. The unit characters concerned are evidently presence (duplex) and absence (simplex) of anterior pigment on a basis of posterior pigment, presence being dominant. The duplex and simplex types can be distinguished at any age. Similar conclusions have been reached independently by Davenport.

Inheritance of Coat-colour in Rats.‡—G. P. Mudge finds that black is dominant to albinism, but the dominance is not complete, some ventral white being always present. It is theoretically conceivable that the incompleteness of the dominance is due to the influence of the factor *s* (= absence of self-pattern) brought in by the albino.

Expected types do not all always appear in any one litter of young, and frequently not until the third litter. Predictions based upon the doctrine of gametic purity and of dominance have not in the author's experiments been falsified by the appearance of any unpredicted types.

The conception (hitherto a matter of deduction) that albinos are the bearers of hidden factors, has been ocularly demonstrated for the piebald, "Irish," and self-patterns. Four types of albinos have been shown to exist.

Completely self-black extracted forms are homozygous for black. Self-grey types may carry both black and piebald recessive. Piebald black-white types may be homozygous for black and piebald, or may carry albinism recessive.

Externally considered, similar zygotes may have a different gametic constitution. Zygotic characters alone are not, therefore, a safe basis for prediction.

With regard to the number of allelomorphs for colour and pattern, the evidence shows that there are two pairs for each, i.e., presence and absence of greyness, presence and absence of blackness, presence and absence of selfness, and presence and absence of piebaldness.

Experimental Estimation of the Theory of Ancestral Contributions in Inheritance.§—A. D. Darbishire has made experiments with peas with the object of finding out if the proportions in which characters

* Arch. Zool. Exper., ix. (1908) Notes et Revue, No. 2 pp. xxiv.–ix. (1 fig.).
† Proc. Roy. Soc., Series B, lxxx. (1908) No. B 537, pp. 85–96.
‡ Tom. cit., pp. 97–121.
§ Op. cit., lxxxi. (1909) No. B 545, pp. 61–79.

segregate in the F_2 generation are affected by the distribution of those characters over the parentage and ancestry of the forms crossed.

The results of the experiments prove :—1. That the phenomena of dominance, and, what is more important, of the segregation of characters in definite proportions, are independent of the ancestry (and of the geographical source) of the parent-forms mated. 2. That the recessive character which reappears in F_5 is as pure as that borne by a pure race, as tested by the results of its union with a pure dominant character. 3. That there is nothing like ancestral contributions within the limits of a single unit-character. 4. That in the attempt to predict the result of a given mating, the somatic characters not only of the parents and of the ancestors of the individuals mated, but of the individuals themselves, may be entirely left out of account, and that the expectation based on a theory of the contents of the germ-cells of the two individuals mated is fulfilled.

b. Histology.

Structure of Dentine.*—V. v. Ebner finds that in typical normal dentine there are, apart from a thin superficial layer under the enamel, no oblique and radial fibres, i.e., fibres which do not cross the canaliculi at right angles. The descriptions of oblique and radial fibres given by v. Korff and Studnička are due to misinterpretation.

Smooth Muscles of Birds.†—A. Lelièvre and E. Retterer have studied the structure of smooth muscle in fowl and pigeon. The sarcoplasm is traversed by a chromophilous reticulum ; the principal trabeculæ are parallel to the long axis, but they are united by oblique and transverse anastomoses. At the contact of two fibres there is a thicker trabecula, which is limited laterally by sarcoplasm, or even separated from the sides of the adjacent cells by a clear cytoplasm traversed by fine branchlets. This cortical reticulum has been described as intermuscular or interfibrillar connective tissue, as uniting bridges, or as exoplasmic alveoli. But it is, according to the authors, of the same nature as the intramuscular reticulum, the meshes containing hyaloplasm instead of sarcoplasm.

Lymphatic Ganglia in Birds.‡—J. Jolly has examined twenty-five species, and found ganglia on the cervical lymphatic only in web-footed forms—duck, teal, goose, and swan. Usually there is a single ganglion on the posterior surface of the jugular vein, below the level of the thyroid. Sometimes there is a second lower down where the axillary and thoracic lymphatics come in. Besides cervical ganglia there are on each side of the aorta, between the origin of femoral and ischiac arteries, at the confluence of lymphatics, small glandular masses which have a ganglionic basis. A section of these various ganglia shows a network of fine lymphoid trabeculæ containing well-developed blood-vessels. In the spongy tissue there are compact lymphoid mass (lymphatic nodules,

* Anat. Anzeig., xxxiv. (1909) pp. 289–309 (9 figs.).
† C.R. Soc. Biol. Paris, lxvi. (1909) pp. 449–52.
‡ Tom. cit., pp. 499–502.

primary follicles) and germinative centres (secondary follicles). In many cases the spongy substance of the ganglion is clearly peripheral, the compact lymphoid substance is aggregated towards the axis, and there is a central lymph sinus. This disposition is simpler than that in the corresponding ganglia in Mammals.

Functional Changes in Bird's Proventriculus.*—J. Michalovsky has studied the glandular cells in the proventriculus of various birds, and compares their appearance, especially as regards the secretory globules, at various times after feeding.

Minute Structure of Japanese Giant Salamander.†—Gakutaro Osawa gives a detailed account, with beautiful figures, of the minute structure of the alimentary, respiratory, and urogenital systems of *Cryptobranchus japonicus*.

Blood of Fishes.‡—Anna Drzewina points out that, although eosinophilous leucocytes are not always absent from the blood of Teleosteans, as has been maintained by several investigators, they are often absent. Only eight species out of forty showed them, viz., *Atherina presbyter*, *Pagellus centrodontus*, *Belone acus*, *Trachinus vipera*, *Crenilabrus melops*, *C. massa*, *Labrus bergylta*, and *L. mixtus*.

Poison-glands of Fishes.§—E. Pawlowsky describes compact multicellular glands in *Sebastes* and *Pelor*, of the same plan as those in *Scorpæna* and *Trachinus*. He found none in *Acanthurus triostegus*, *Blepsias cirrhosus*, or *Muræna helena*.

Efferent Ducts of Testis in Chimæra.‖—W. N. Parker and T. H. Burlend find that the efferent ducts, which are doubtless, as in Plagiostomes, derivatives of certain of the embryonic mesonephric tubules, have become completely emancipated from the main body of the mesonephros, and that probably one of them only, serving as a collector, remains in connexion with the spermiduct. From the embryological point of view there is, therefore, a representative of a "Geschlechtsniere," but the actual mesonephros of the adult does not include a sexual portion ("cranial zone"), as is usually the case in adult Plagiostomes. The term epididymis should be dropped, for it is necessary to distinguish clearly between the coiled anterior end of the spermiduct (= vas deferens, Wolffian duct, mesonephric duct), and the so-called sexual portion (anterior portion or "cranial zone") of the mesonephros of Plagiostomes.

c. General.

Tuberculum olfactorium.¶—G. Elliot Smith has studied in various Mammals (Monotremes, Marsupials, Edentates, etc.) the rounded cap of irregular grey matter which lies midway between the cerebral attach-

* Anat. Anzeig., xxxiv. (1909) pp. 257–75 (8 figs.).
† MT. Med.-Fakultät Univ. Tokyo, viii. (1908) pp. 19–93 (15 pls.).
‡ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 514–16.
§ Anat. Anzeig., xxxiv. (1909) pp. 314–30 (6 figs.).
‖ Tom cit., pp. 331–6 (4 figs.).
¶ Tom. cit., pp. 200–6 (2 figs.).

ment of the pedunculus olfactorius and the optic chiasma. He finds that it is certainly a part of the smell-centre, and that its function is probably almost exclusively olfactory. It is linked to the olfactory bulb by a direct tract, which arises in the formatio bulbaris.

Races of Swine.*—Adolf Pira makes some elaborate contributions to the history of swine, based chiefly on a study of the sub-fossil remains in Sweden. These give evidence of seven forms—*Sus scrofa ferus antiquus*, *Sus scrofa palustris*, etc.—whose relationships are discussed.

Albinism in Birds and Mammals.†—L. Petit sen. has observed a number of interesting cases of albinism, in most cases partial. His collection includes a perfectly white squirrel with red eyes, a grebe (*Podiceps auritus*), with all the dorsal surface dull white, a cream-coloured (isabelle) woodcock, a partridge of the same colour, a blackbird covered with white spots, a perfectly white tree-pipit, a white and greyish white sand-martin, and a great many more.

Remains of Parasphenoid in an Opossum.‡—Hugo Fuchs discusses and dismisses the theory that the vomer of Mammals corresponds to the parasphenoid of lower Vertebrates. He has found, however, in an embryo of *Didelphys* a vestige of the true parasphenoid insinuated between the divergent posterior ends of the vomerine primordia.

Notes on Clawless Otters.§—Einar Lönnberg has some notes on *Lutra capensis hindei* and other African clawless otters. The structure of the skull and the dentition exhibit adaptations to feeding on molluscs and crabs.

Affinities of the Okapi.‖—J. Fraipont gives an outline of his forthcoming monograph on the Okapi, and discusses its affinities. It has affinities with *Palæotragus* of the upper Miocene, but is in many ways more primitive; it has also affinities with the giraffe, but is nearer *Palæotragus*; in some respects it is more primitive than *Palæotragus*.

Partial Albinism in Grass Snake.¶—G. Tornier describes a case of partial albinism in *Tropidonotus natrix*, and shows that the yellowish-white or bluish-white ground colour with rows of reddish-brown spots corresponds to a transitory stage in the normal ontogeny. It is really a case of arrested development, and the author suggests that it is due to insufficient yolk. His experiments in producing albino axolotl larvæ point in this direction. It is also noted that a southern variety of grass snake which has a lighter colour has less yolk.

Mimicry in Snakes.**—R. Sternfeld cites a number of cases of close resemblance between a relatively rare unprotected snake and the

* Zool. Jahrb., 1909, Supp. 10, Heft 2, pp. 233-426 (52 figs.).
† Bull. Soc. Zool. France, xxxiv. (1909) pp. 32-5.
‡ Anat. Anzeig., xxxii. (1908) pp. 584-90 (3 figs.).
§ Arkiv f. Zool., iv. (1908) No. 12, pp. 1-11 (1 pl.).
‖ Bull. Classe Sci. Acad. Roy. Belgique, 1908, No. 12, pp. 1097-1130 (4 pls).
¶ SB. Ges. Nat. Freunde Berlin, 1908, pp. 196-200 (4 figs.).
** Tom. cit., pp. 89-91.

commonest poisonous snake in the region. Thus *Dasypeltis scabra* is very like *Bitis caudalis*; again, the *Dasypeltis* of Upper Egypt and Abyssinia is very like the dreaded *Echis carinata*, and the small colubrid *Rhamphiophis multimaculatus* strikingly resembles *Bitis caudalis*.

Musculature of Tongue in Geckos.*—E. Zavattari gives an analysis of the musculature of the tongue in ten species of geckos, discussing the hyoglossal, genioglossal, longitudinalis, and transversalis muscles. As regards the relations of the hyoglossal, the Geckos differ from all other lizards, and, indeed, from all other reptiles.

Root Growing through Lizard's Egg.†—G. Tornier describes a curious case where the rhizome of a sedge had grown through two eggs of *Lacerta agilis*, dissolving away the egg-shell at the entrance and exit. It was interesting to find that the eggs contained embryos which were normal. In the uppermost of the two eggs, which was perforated centrally by the rhizome, there were actually three rootlets penetrating the embryonic membranes and entering the yolk-sac. In one case a rootlet passed into the embryo's mouth. Yet the embryos were normal. The quaint case is a fine instance of resistance and developmental energy.

Influence of Darkness and Starving on Chromatophores of Axolotl and Goldfish.‡—J. F. Ogneff found that axolotls kept in darkness and starved at the same time show atrophy of the black chromatophores of the internal organs, in the serous membranes, and in the skin. A slight hint of this occurs when newt and frog are kept in the dark, but hunger seems to have no effect here. It seems that phagocytes destroy the pigment cells, carry off the pigment, and may set up as chromatophores elsewhere. Goldfish kept in the dark gradually change their colour to uniform brownish red; numerous black cells appear in the serous membranes of the body cavity, in the anterior part of the eye where the cornea joins the sclerotic, and so on. The reaction differs in detail from that in the axolotl. What happens in the axolotls throws light on the blanching of cave animals.

Drowning of Young Toads.§—L. Vaillant notes that on July 1 last year incalculable numbers of young toads appeared on one of the walks in the Jardin des Plantes in Paris, making their way from a small pond. They were about 1 cm. long and extraordinarily active: but the point of the note is that when some of these young toads were put into an aquarium they became inert—as if drowned—in a few minutes.

Horny Fibres of Selachians and Fin-rays of Teleosteans.‖—H. E. Ziegler refers to A. von Szilly's contention that the fin-rays of Teleosteans arise from the ectoderm, and brings forward evidence to show that these peculiar integumentary bones are wholly mesodermic.

* Atti R. Accad. Sci. Torino, xliv. (1909) pp. 282-90 (1 pl.).
† SB. Ges. Nat. Freunde Berlin, 1908, pp. 191-4 (3 figs.).
‡ Anat. Anzeig., xxxii. (1908) pp. 591-607 (4 figs.).
§ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 11-12.
‖ Zool. Anzeig., xxxiii. (1908) pp. 721-7 (4 figs.).

The so-called "horny fibres," which are better called "elastoidin filaments," are intercellular products of mesenchyme cells. In the fatty fin of the Salmonidæ the elastoidin filaments are well seen, and here they are distinctly the product of mesenchyme cells.

Heliotropism of Pelagic Animals.*—J. Loeb has experimented with Copepods, larvæ of *Polygordius*, and other plankton organisms in order to get at a better understanding of the rising to the surface in the evening and the descending movement in the morning. There is a periodic change in the direction of the heliotropism: they are negatively heliotropic in the morning, positive in the evening. Raising the temperature makes them negative; decrease of acids (especially CO_2) in the water lessens the positive heliotropism; very intense light makes some organisms negative. There are other factors, such as the friction of the water; for (as Wolfgang Ostwald has pointed out) this varies with the temperature, and for pelagic animals whose specific gravity is greater than that of water it is easier to sink during the day than at night.

Animal Life of San Bernardino Mountains.†—Joseph Grinnell gives an account of the "Biota" of the largest high mountain group in southern California. He discusses the life zones as marked by fauna and flora, and pays particular attention to the bird population and the influences modifying it. He makes notes on 139 birds, 35 mammals, and 20 species, not merely as to distribution, but as to habits as well.

Cause of Appendicitis.‡—A. E. Shipley suggests, as others have done, that Entozoa may play a part in the ætiology of appendicitis. There is evidence that *Oxyuris vermicularis* sometimes perforates the wall of the alimentary canal, and thus diffuses pathogenic bacteria. Similarly *Ascaris lumbricoides* and *Trichocephalus trichiurus* may by their punctures and perforations distribute bacteria which set up inflammation.

Are there Suprarenal Bodies in Invertebrates?—H. Poll § discusses this interesting question and the suggestions that have been made by those who answer it in the affirmative. His own view is that certain cells of the ventral ganglia of the leech are "chrome brown" ganglion-cells and are analogous to suprarenal tissue.

Tunicata.

Constancy of Histological Elements in Oikopleura longicauda.‖ E. Martini means by this title that precisely similar cells are found in precisely the same place in every specimen, and in similar relations to their surroundings. He shows this to be the case to a very remarkable

* Biol. Centralbl., xxviii. (1908) pp. 732–6.
† Publications Univ. California, Zoology, v. (1908) pp. 1–170 (24 pls.).
‡ Parasitology, i. (1908) pp. 263–79.
§ SB. Ges. Nat. Freunde Berlin, 1908, No. 1, pp. 18–23 (1 pl.).
‖ Zeitschr. f. wiss. Zool., xcii. (1909) pp. 563–626 (3 pls. and 22 figs.).

extent in *Oikopleura longicauda* as regards the whole of the nervous system, the taste-organ, the tactile organs of the pharynx entrance, the notochord, the oikoplast-epithelium, and the small groups at the spiracular opening.

Ascidian Fixed in Skin of Holothurian.*—E. Chatton describes what is probably "an œcological aberration"—the occurrence of a small (undetermined) Ascidian fixed in the skin of *Holothuria tubulosa* at Banyuls.

INVERTEBRATA.

Mollusca.

α. Cephalopoda.

North Sea Cephalopods.†—E. S. Russell makes a preliminary report on the Cephalopods collected by the 'Goldseeker' on the east and north coasts of Scotland, round the Shetlands, and between the Shetlands and the Faeroes. The collection includes representatives of sixteen species, of which three are new: *Polypus faeroensis* (allied somewhat closely to *P. arcticus*), *Brachioteuthis bowmani* (very close to the only other species of the genus *B. beanii*, and *Taonidium pfefferi* (not unlike *T. suhmi*, and in some respects closely approaching *Owenia megalops*). Examination of specimens from Naples and from Plymouth has convinced the author that the common *Moschites cirrosa* Lamarck of the British shores is identical with the Mediterranean *M. aldrovandi*. The distinctly northern *Rossia glaucopis* Lovén was got as far south as Kinnaird Deeps; about twenty specimens of *Sepiola aurantiaca*, hitherto recorded only from Mediterranean waters, were taken at various localities on the east coast of Scotland, near Shetland, and in the Faeroe Channel. Another new record is *Calliteuthis reversa* Verrill, which has been found in deep water off the north-eastern coast of America (Verrill), in New Zealand and Japanese waters (Hoyle), and in the Mediterranean (Pfeffer).

β. Gastropoda.

New Pteropod from New England.‡—C. H. Danforth describes *Pædoclione doliiformis* g. et sp. n. The body is barrel-shaped; the head and posterior end are retractile; there are three bands of cilia like those of Pteropod larvæ; the head has one (anterior) pair of tentacles; the cephalocones are unarmed, three in number; hood-sacks are replaced by two thickened areas (ankistrophores) on the dorsal wall of the pharyngeal cavity bearing a few (5 to 8) rather strong hooks; the radula has a broad non-cuspidate median tooth and five lateral teeth on either side; the foot is divided into three lobes; the viscera fill up the entire posterior part of the body. It may perhaps turn out to be a pædogenetic larval form, but in any case it is new.

* Bull. Soc. Zool. France, xxxiv. (1909) pp. 25–7 (1 fig.).
† Ann. Nat. Hist., iii. (1909) pp. 446–55.
‡ Proc. Boston Soc. Nat. Hist., xxxiv. (1907, received 1909) pp. 1–19 (4 pls.).

Use of Slime-threads in Marine Gastropods.*—N. Colgan has observed ten species climbing by the help of suspensory slime-threads. The animals can drop from the surface, can hang suspended, and can climb up again. The species studied were: *Runcina hancocki*, *Limapontia nigra*, *Doto coronata*, *Eolis farrani*, *E. drummondi*, *Skenea planorbis*, *Rissoa striata*, *R. parva*, and *R. cingillus*. In the young of the common bivalve *Modiolaria discors* the use of slime-threads was also seen. On a vertical surface of plate-glass *Rissoa striata* can crawl an inch in three minutes, *Trochus zizyphinus* an inch in one minute, *Eolis farrani* and *E. drummondi* at the dizzy rate of an inch in fifteen seconds and thirteen seconds respectively.

δ. Lamellibranchiata.

Striped Muscle in Mantle of Lamellibranchs.†—W. J. Dakin has found striped muscle in the mobile mantle edge of *Pecten jacobæus* and *P. opercularis*. The striation is not oblique like the cardiac and adductor muscles of most Lamellibranchs, but apparently transverse like the adductor muscle of *Pecten*, though perhaps not quite so regular. "It is interesting to note that the muscles which show such an obvious striation are engaged in rapid movements, which are also organised and related to the closing and opening movements of the shell in swimming, another case, therefore, of the connection between striation and rapid contraction and relaxation."

Pecten.‡—W. J. Dakin has prepared an admirable memoir on *Pecten*. He discusses the animal's behaviour and gives a full account of its structure. In connection with some of the organs the physiological side receives careful attention. It is shown, for instance, that the digestive gland contains proteolytic, amylolytic, and lipolytic ferments. A detailed account is given of the eyes, in regard to which there has been much confusion. The development of the animal is dealt with very briefly. The memoir concludes with a chapter on the economic importance of the scallop, both for human food and for bait.

Life-history of Canadian Oysters.§—J. Stafford gives an account of some of the larval stages he has found in the plankton at various depths in Richmond Bay, Prince Edward Island. The free-swimming period is probably close on a month. The larvæ feed and grow while free-swimming, and pass through a straight-hinge stage to an umbo stage. Normal fixation takes place when the larval shell is about 0·38 mm. in length, and then the spat period begins. A metamorphosis occurs with loss of larval organs (velum, foot, eye-spot, otocysts, etc.) and growth of new organs (spat-shell, additional gills, palps, etc.). The larval shell is asymmetrical, as is also to some extent the contained body. Some account is given of the foot, the pedal ganglia, the otocysts, the eye-spots, and the byssus gland, and some questions of economic importance are discussed.

* Ann. Nat. Hist., iii. (1909) pp. 354–62.
† Anat. Anzeig., xxxiv. (1909) pp. 227–30 (5 figs.).
‡ Liverpool Marine Biology Committee Memoirs, No. xvii. (1909) pp. 1–36 (9 pls.).
§ Amer. Nat., xliii. (1909) pp. 31–47 (1 pl.).

Observations on Pinna.*—Mario Stenta gives an interesting account of the structure of *Pinna*, in which he seeks to correlate the peculiarities of structure with the peculiar nature of its sedentary life, which is quite different from that of mussel, oyster, *Pholas*, or any other sedentary bivalve.

Movements of Cyclas.†—F. Martin describes how small specimens of *Cyclas* or *Sphærium* glide along beneath the surface film exuding a double trail of mucus. From the pallial slit drops of mucus are passed out at regular intervals, corresponding to the expansion and contraction of the foot, but more rapidly.

Arthropoda.

α. Insecta.

Treatise on Entomology.‡—A. Berlese deserves congratulation on the completion of the first volume of his great work on Insects. The last instalment deals with the reproductive organs, oogenesis, spermatogenesis, and related topics.

Sense of Direction in Bees.§—Gaston Bonnier has studied the return of bees, from a distance of up to three kilometres, straight to the hive. Bees carried afield in a box find their way to a hive hidden behind woods. Bees blinded with blackened collodion find their way. Therefore vision is not necessary. The removal of the antennæ, which bear the so-called olfactory organs, does not prevent the return. Experiments show that bees are capable of distinguishing between two directions which form a very acute angle. Everything points to the conclusion that bees have a particular "sense of direction," more or less comparable to that of carrier pigeons, which has its seat in the cerebral ganglia.

Metamorphosis in Isosoma graminicola.‖—W. Docters van Leeuwen has studied in particular the changes in the structure of the food-canal in this gall-making Chalcid. We select the part dealing with the mid-gut. In the young larva the intestinal wall consists of a layer of intestinal cells and muscle-cells; during the growth of the larva wandering cells insinuate themselves between the muscularis and the larval epithelium, and become imaginal intestinal cells. When nutritive material begins to be taken from the galls the imaginal cells show a vacuole which gradually increases in size. The larval cells increase and so do the imaginal cells. The latter approach one another and form a new intestinal epithelium. In the beginning of the pupal life the larval cells are destroyed, and the imaginal cells lose their vacuoles. By a shortening of the mid-gut the imaginal cells are pressed together and acquire their definite form. The muscle-cells disappear and are replaced from wandering cells.

The author deals also with the fore-gut and the hind-gut. He

* Atti R. Ist. Veneto. lxvii. (1908) pp. 495–518.
† SB. Ges. Nat. Freunde Berlin, 1908, Nos. 2 and 3, pp. 38–40 (3 figs.).
‡ Gli Insetti. Milano, 1909, pp. i–xii, 897–1004 (3 pls., and figs. 1198–1292).
§ Comptes Rendus, cxlviii. (1909) pp. 1019–23.
‖ Tijdschr Nederland. Dierk. Ver., xi. (1908) pp. 1–35 (2 pls.).

protests very emphatically against making theories of metamorphosis in the present state of knowledge. Thus there is prominent phagocytosis in Muscids, but in many other insects, such as this *Isosoma*, there is practically none.

Respiration of Aquatic Insects.*—P. Portier has described in the larva of *Dytiscus* a prestigmatic chamber or "chambre de sûreté," which keeps water from entering the tracheal system. It is a cylinder of soft chitin which opens by a false stigma; the true stigma, where the spiral thread of the trachea begins, is at the base of the chamber.

He finds that similar arrangements occur in other aquatic insects that breathe at the surface—larvæ of *Hydrophilus*, *Hydrobius*, and the like. The apparatus reaches its most perfect differentation in the larvæ of *Hydrocampa*.

Stigmata of Aquatic Insects.†—P. Portier points out that fatty fluids can enter the stigmata, though water does not. It is a question of capillarity. When oil is put on the stigmata of an aerial insect it soon penetrates the tracheal system, and a caterpillar, for instance, dies in a few minutes. When the same is done with the larvæ of aquatic insects, such as *Hydrophilus*, the oil is prevented from entering, or if it enters there are various ways in which the insect seeks to avoid the choking consequences.

Digestion in Larvæ of Water Beetles.‡—P. Portier calls attention to the gluttony of the larvæ of *Dytiscus*, *Hydrobius*, and *Hydrophilus*. They eat so much that they sink to the bottom. There they show phenomena of asphyxiation, and they lighten themselves by emitting liquid at the fine tips of the hooks or at their base. The anterior and median part of the mouth is physiologically closed.

The larvæ can inject a large quantity of digestive liquid into their prey. The digestive fluid collects in *Dytiscus* in a large intestinal cæcum; it has a dark colour, it is neutral or slightly alkaline, it contains a trypsin and probably also a tyrosinase. The poisonous character of the bite seems to depend on a special toxin, but the author has not found the gland. In the larva of *Hydrobius* there is no cæcum, but the digestive fluid accumulates in the rectum. In *Hydrophilus* the hooks do not seem to be perforated at all.

Sensorial Papillæ on Proboscis of Lepidoptera.§—E. Guyénot describes the varied structure of minute cylindrical papillæ, with a ring at the base, a cone at the tip, and diverse ornamentations, which occur on the proboscis of Lepidoptera. It would be interesting to correlate their variety of number and size with differences in the habits of the insects.

Excretion during Metamorphosis of Heterogenea.‖—Katharina Samson has studied the conditions of the Malpighian tubules in the metamorphosis of the caterpillars of *Heterogenea limacodes*. The

* C.R. Soc. Biol. Paris, lxvi. (1908) pp. 452-4.
† Tom. cit., pp. 496-9.
‡ Tom. cit., pp. 379-82.
§ Tom cit. pp. 525-7.
‖ Zool. Jahrb., xxvi. (1908) pp. 403-22 (2 pls. and 2 figs.).

excretory function of the Malpighian tubules is admitted, but they undergo degeneration, and one of the main points of the paper is to show that the fat cells (in which there are crystals like those in the vasa Malpighii), have a definite excretory role.

Thaumatoxena.*—Ivar Trägårdh discusses the position of the remarkable termitophilous insect known as *Thaumatoxena wasmanni* Breddin and Börner. The structure of the foot with its two claws, two pulvilli, and the empodium is certainly that of a typical Dipteron. It is interesting to find the same kind of shape—an unassailable shape—in *Trilobitideus*, which is a beetle. The convergence is "amazing."

Tumbu-fly.†—F. Smith, A. P. Blenkinsop, and E. E. Austen contribute notes on the tumbu-fly (*Cordylobia anthropophaga* Grünb.), in Sierra Leone. The larva burrows in the skin of man (and of various Mammals). A swelling forms with a fine opening to the exterior. Round about there is usually a deposit of black excrement. In the case of children and helpless patients who are unable to remove the parasite, the larva may work its way out. It pupates in or on the earth. The mode of infection is uncertain. There is considerable resemblance between the tumbu-fly and the floor maggot-fly (*Auchmeromyia luteola*).

Whitefly Studies.‡—E. W. Berger gives a lucid account of *Aleyrodes citri* and *A. nubifera* sp. n., which infest orange trees in Florida. He explains how the larvæ may be infected with parasitic fungi by spraying on the sponges at the proper time.

White Wax of China.§—E. Bugnion and N. Popoff had in a previous paper referred this product to *Flata nigricornis* which lives on *Stillingia sebifera*, but they now correct this by saying that while some of the wax may have this origin, most is due, as various travellers and entomologists have pointed out, to the male of *Coccus ceriferus*, which lives on *Ligustrum glabrum*, *L. lucidum*, *Fraxinus sinensis*, *Rhus succedanus*, *Hibiscus syriacus*, etc. The remarkable sexual dimorphism is described. The secretion of wax is increased when the insects are taken to mountainous regions and put on to *Fraxinus sinensis*. A great waxy mass is secreted by a crowd of males on the branches. The chemical composition of the wax is discussed.

Autotomy of Hemelytra in certain Halobatinæ.‖—J. R. de la Torre Bueno has observed in *Trepobates pictus* and in *Rheumatobates* an interesting self-mutilation. It occurs in both sexes, and consists in actively breaking off the membrane of the hemelytra along a definite suture. It is suggested that the meaning of the autotomy is to facilitate copulation.

* Arkiv Zool. iv. (1908) No. 10, pp. 1–12 (7 figs.).
† Journ. Roy. Army Med. Corps, 1908, pp. 14–24. See also Zool. Centralbl., xv. (1908) pp. 632–3.
‡ Florida Agric. Exp. Stat., Bull. No. 97 (1909) pp. 1–71 (19 figs.).
§ Bull. Soc. Vaud. Sci. Nat., xliv. (1908) pp. 273–83 (1 pl.).
‖ Ohio Nat., ix. (1908) pp. 389–92 (4 figs.).

African Mantids and Related Forms.*—F. Werner deals with a number of interesting forms of Amorphoscelidæ, Mantidæ, and Harpagidæ, such as *Chloroharpax* g. n., which links the last two families together, and the very much isolated *Auchmomantis* g. n.

Galls of the Lower Rhine.†—J. Niessen calls attention to some new animal-galls and to the abundance of many types in the Niederrhein region. He has collected 540 Zoocecidia, 4 Helminthocecidia, 140 Acaro-, 120 Hemiptero-, 150 Diptero-, 100 Hymenoptero-, 4 Lepidoptero-, 16 Coleoptero-cecidia, and 6 of doubtful origin.

β. Myriopoda.

New North American Millepedes.‡—F. Silvestri describes *Urochordeuma bumpusi* g. et sp. n. and *Rhiscosomides meineri* g. et sp. n., both so unique that two new families Urochordeumidæ and Rhiscosomididæ require to be established to receive them.

δ. Arachnida.

Social Mexican Spider.§—L. Diguet describes the habits of a small spider called in Mexico, the Mosquero, parts of the nests of which are hung up in the houses for getting rid of flies at the wet season. The spider inhabits high altitudes and lives gregariously; it makes a huge nest (up to 2 square metres) in oaks and other trees. The interior of the nest has a curious spongy appearance. A minute beetle (*Melanophthalma*) acts as a scavenger, and another spider lives as a commensal in the nest.

E. Simon ‖ establishes for this social spider a new genus, *Cœnothele*, intermediate between *Dictyna* and *Phryganoporus* in the family Dictynidæ. He gives a description, and names the spider *Cœnothele gregalis*. The commensal spider is *Pœcilochroa convictrix* sp. n. The gregarious habit is known in *Phryganoporus* (Australian) and *Stegodyphus* (S. Africa and India).

Species of Arrhenurus in the United States.¶—Ruth Marshall gives an account of the numerous N. American species of this genus of Hydrachnids. It is a highly differentiated and widely distributed genus, and the species, which are usually found in shallow clear waters, may be grouped in four sub-genera.

Demodex and Disease.**—A. Borrel, with the collaboration of Gastinel and C. Goresen, brings forward evidence which goes to show that *Demodex* and sedentary Acarines, unimportant in themselves, may play a part in the diffusion of cancer. The two are often together about the mammæ for instance. Borrel makes out another probability in the case of leprosy.

* Ber. Senckenberg Nat. Ges., 1908, pp. 31–56 (1 pl.).
† SB. Nat. Ver. Preuss. Rheinlande und Westfalens, 1907, 2te Hälfte, published 1908, pp. 91–4.
‡ Atti (Rend.) R. Accad. Lincei, 1909, pp. 229–33.
§ Comptes Rendus, cxlviii. (1908) pp. 735–6.
‖ Tom. cit., pp. 736–7.
¶ Trans. Amer. Micr. Soc., xxviii. (1908) pp. 85–140 (16 pls.).
** Ann. Inst. Pasteur, xxiii. (1909) pp. 97–128 (4 pls.).

ε. Crustacea.

Behaviour of Ocypoda arenaria.*—R. P. Cowles has made a study of the interesting Brachyuran, *Ocypoda arenaria*, the "sand-crab" of the Atlantic coast of the Southern States. He found that the adult made two kinds of burrows. One consists of a single tunnel extending downwards in the sand for three or four feet. The other is shorter, and has a passage branching off from it, used for escape. Young crabs make burrows only a few inches deep. Breeding apparently took place in the spring and early summer. The sand-crab is a scavenger and a cannibal. It was not conclusively shown that it was stimulated by the odour of food, but experiments seemed to point to this.

The eyes are, for crustacean eyes, highly developed ; they are sensitive to considerable differences in the intensity of light : they do not react to different colours ; they aid greatly in the search for food, and in the accuracy of locomotion. The colour-pattern seen through the carapace of *Ocypoda* changes in intensity under different conditions of temperature and light. In the absence of light, when the temperature is anywhere between 22° and 45° C., and undoubtedly when it is even lower or higher, a light coloration occurs. Generally in diffuse light, and even in direct sunlight, a dark coloration appears, provided the temperature is not too high. Usually at low temperatures a dark coloration appears, provided the eye is stimulated by light. At high temperatures, above 35° C., a light coloration is the rule, and it occurs independently of light.

No indication of audition was observed. The so-called "auditory organs" are equilibrating organs. There is a stridulating ridge on the palm of its large chela. Any sound which it may make is probably not heard by any other individuals, but the vibrations produced are probably felt by other *Ocypodas*.

The tactile sense is well developed. With the body orientated in a fixed position, the animal can move in practically any direction. It runs with a considerable degree of accuracy, and undoubtedly has a sense of position and distance. In locomotion these crabs are guided by differences in the lighting of surfaces, by tactile stimuli, by differences in muscular effort, and by the stimulation of the equilibrating organs resulting from a tilting of the body. The sand-crab lives on land, and only goes to the water to moisten the gills. It usually dies if exposed to direct sunlight without water for more than four hours. It can live in the burrows without fresh sea-water for at least forty-eight hours. The "Aufbäum reflex" described by Bethe, is an attitude of defence. The animal often hides from man by simply settling down and throwing sand over its body. It is sometimes found in a resting or "sleeping" condition, when it does not react to many of the ordinary stimuli. The death-feigning reaction is exhibited under certain conditions. There is evidence that the animal has the power of forming definite associations and habits.

* Publications Carnegie Inst. Washington, No. 103 (1909) pp. 1–41 (4 pls. and 10 figs.).

Luminescence in Crustacea.* — E. Kiernik has observed luminescence in the Copepods *Chiridius obtusifrons* and *Euchæta*, in the Schizopod *Boreophausia inermis*, in the eyes of *Pasiphæa etarda*, and in a number of other forms.

Notes on Palinuridæ.†—W. T. Calman finds that *Puerulus* Ortmann (= *Puer* Ortmann) is a valid genus of Palinurideæ, of which the type species is *P. angulatus* Spence Bate. But the remaining species referred to *Puerulus*, *P. pellucidus* Ortm., *P. spiniger* Ortm., and *P. atlanticus* Bouvier (= *Panulirus inermis* Pocock), are founded on specimens in a stage of development intermediate between the *Phyllosoma* and the adult form, called by Boas the "natant stage." The above-mentioned *P. spiniger* Ortm., is the natant stage of *Panulirus versicolor* (Latreille), and it passes into the adult form without any perceptible increase of size, while preserving unchanged the general pattern of coloration. The natant stage in *Jasus* differs from those of *Puerulus* in possessing a median rostral tooth.

Mediterranean Schizopods.‡—W. M. Tattersall has examined the rich material of Schizopods collected by the 'Maia' and 'Puritan' during cruises in the Mediterranean. He has notes on thirty species, including *Parerythrops lobiancoi* sp. n., *Pseudomma kruppi* sp. n., and *Calyptomma puritani* g. et sp. n. In *Calyptomma* the eyes are in the form of an ocular lamina, resembling somewhat that of the genus *Pseudomma*, partly hidden by the vaulted form of the carapace; the lamina is without any indication of a median cleft, absolutely contiguous, and produced in front into two short pointed processes; the visual elements are rudimentary. Of the thirty Schizopods discussed, seventeen are recorded for the first time from the Mediterranean. Some interesting tables showing distribution are given.

Visceral Nervous System in Squilla mantis.§—G. Police distinguishes an anterior and a posterior portion. In the anterior portion there are three centres, two paired and one unpaired; in the posterior portion there are two paired nerves and one unpaired. The system is described and compared with that in other Decapods.

Studies on Liriopsidæ.‖—Maurice Caullery has studied two Epicarids belonging to the Cryptoniscid group. One of them, *Danalia curvata*, is very common on *Inachus scorpio*, parasitised by *Sacculina neglecta*; the other is *Liriopsis monophthalma*, parasite of *Peltogaster curvatus*, on *Eupagurus meticulosus*. He discusses the various phases in the life-history of these forms, their Epicarid and Cryptoniscid larvæ, the mutual affinities of Cryptoniscids, and the castrating effect of Liriopsids on the Rhizocephala, on which they are parasitic.

* Zool. Anzeig., xxxiii. (1908) pp. 376–80.
† Ann. Nat. Hist. iii. (1909) pp. 441–6.
‡ MT. Zool. Stat. Neapel, xix. (1909) pp. 117–48 (1 pl.).
§ Tom. cit., pp. 144–8 (1 pl.).
‖ Op. cit., xviii. (1908) pp. 583–643 (1 pl. and 8 figs.).

Eyes of Apus.*—W. Wenke finds that in the eyes of *Apus productus* the cornea is without facets; there are true crystalline cones which have Semper's nuclei in their sheath; each retinula has usually seven optic cells; the nuclei of these cells lie in the proximal part about the same level. At the pointed pole of the crystalline cone there is a special zone (Hesse's Schaltzone), in which the neurofibrils running parallel to one another are seen emerging from the coalesced rhabdomeres ("Stiftchen"). The neurofibrils bend round, insinuate themselves between nucleus and wall of the retinula-cell, and penetrate the basal aperture of the retinula-cell or the basal membrane. According to the illumination there is movement of the pigment granules: they accumulate on the membranes turned to the light. The structure of the eye is illustrated by exceptionally good figures.

A dorsal frontal organ passes from each optic ganglion to the hypodermis. The median eye is tetrapartite. Its optic cells are prismatic and without the rods. The chief nerve-strand of each prism-cell divides into as many tufts as the prism has sides. Each tuft forms at the cell-membrane a "Schaltzone," which passes into a rhabdomere.

Varieties of Daphnia.†—R. Woltereck has studied two varieties of *Daphnia longispina*, which seem to be elementary species. But extreme and opposed nutritive conditions induce the production of variants that lessen the divergence between the two varieties, though some difference persists. These artificially induced variants tell against the idea of the origin of the varieties by mutation. The group of lacustrine species of *Daphnia* (excluding *D. magna*, but probably including *D. pulex*), is to be regarded as a single species with numerous "fixed local varieties," or as a large number of species. Woltereck regards these varieties or species as due to the ceaseless variability—in dependence on environment. Convergence is very important in this connection, but selection is of secondary moment as regards the differentiation of the external form of Daphnids. There is very little evidence of mutation.

Species of Cyclops.‡—Esther F. Byrnes has studied fifteen species of *Cyclops* in the fresh water of Long Island, with special reference to their variability. A new species *C. virido-signatus* is described. Comparison with forms from the western lakes brings out the wide distribution of some species. It is noted that great abundance of a species may be followed by decline, till only a few representatives remain. There is considerable variability in armature and proportions. Spines and setæ are interchangeable. An apparent variation in the spines of *Cyclops* is often due to a retardation of growth in the posterior appendages. Size is greatly influenced by habitat. The study of variation is greatly complicated by the occurrence of pædogenesis, by the occurrence of heterogeneous forms in certain groups, and by retardations of metamorphic changes which look like variations but are afterwards obliterated. The greatest ranges of variability have been found among those forms

* Zeitschr. wiss. Zool., xci. (1908) pp. 236-65 (1 pl. and 13 figs.).
† Ver. Deutsch. Zool. Ges., 18 Jahres., 1908, pp. 234–40.
‡ Cold Spring Harbor Monographs, vii. (1909) 43 pp., 15 pls.

that inhabit stagnant water where conditions are most variable and where only plastic forms could live permanently by adjusting themselves to their varying conditions of life.

Copepod Parasites of Tunicates.*—E. Chatton discusses the Copepod genus *Ophioseides*, the terminus of degeneration in the series of Ascidicolidæ, and describes *O. joubini* sp. n. from *Microcosmus sabattieri*. The female has a vermiform, sub-cylindrical body, the male is harpacticiform.

Annulata.

Multiple Cephalisation in Syllis.†—A. Michel describes several cases, the most striking being in a specimen of *Syllis amica*, where he found twelve supplementary heads on successive rings and appendages as well as eyes. In fact some of the abnormal rings were complete heads of the stolonial type.

Innervation of the Pharynx in Oligochæta.‡—Vaclav Maule gives a detailed account of this, with special reference to *Pachydrilus* (*Mesenchytræus*) *beumeri*. There are two pairs of pharyngeal ganglia with complex connections.

Nematohelminthes.

Development of Nematodes.§—E. Martini finds that both cœloblastula and placula embryos are formed, and that both epibolic and invaginate gastrulation occurs. The blastopore and the archenteron entirely disappear. There is no cœlom or mesoblast, but only a mesenchyme. The ectodermic epidermis is represented by the subcuticula and lateral areas. The fore-gut is ectodermic, the mid-gut is formed from two rows of endoderm cells which form a cavity between them, the hind-gut is probably due to ectoderm and mesoderm. It is noteworthy that the sex-cells are easily distinguishable from the somatic cells.

The development is absolutely determinate from start to finish, that is to say, specific blastomeres form specific organs. There is very little difference in the early ontogeny of different species. The Meromyaria are the most primitive.

Oxyuris in connection with Appendicitis.‖—Fr. Unterberger finds that *Oxyuris vermicularis* is able to penetrate into the normal intestinal mucosa, but that the membrane shows no appreciable reaction to the parasite. Whether the worm can perforate the wall, and why the deposition of ova sometimes happens in the wall of the intestine, are points that require further investigation.

* Bull. Soc. Zool. France, xxxiv. (1909) pp. 11–19 (8 figs.).
† Comptes Rendus, cxlviii. (1909) pp. 438–9.
‡ SB. k. Böhm. Ges. Wiss., 1908, No. ix., pp. 1–21 (2 pls.).
§ Zeitschr. wiss. Zool., xci. (1908) pp. 191–235 (13 figs.).
‖ Centralbl. Parasitenk., xlvii. (1908) Abth. i., pp. 495–503 (1 fig.).

Nematodes in Grouse.*—A. E. Shipley notes that *Syngamus trachealis* occurs as a rarity, that *Trichosoma longicolle*, which occurs in the duodenum and upper part of the small intestine, causes great destruction of the lining epithelium, and that the delicate transparent *Trichostrongylus pergracilis* is intimately associated with grave disease.

Platyhelminthes.

Spermatozoa of Planaria lactea.†—J. Hammerschmidt describes the extraordinary elongated spermatozoa of this Turbellarian and compares them with others in the same class. He shows that in spite of their apparent divergence they exhibit the usual parts. The head is drawn out, the tail is short in proportion, but bears two supplementary flagella of great length.

Planaria alpina on Northern Swedish Mountains.‡—Nils von Hofsten records the abundant occurrence of this Planarian in streams on the northern mountains. This is of interest in connection with Voigt's theory that the centre of distribution is to be found in the Alps —its assumed pre-glacial home. The author is not inclined to regard the species as a glacial relict. He also notes, as against Voigt and others, that he has often found *P. alpina* in Sweden in situations which it could not have reached by active migration.

Observations on Otoplana.§—J. Wilhelmi gives an account of the external characters and behaviour of three Mediterranean Alloiocœla: *Otoplana intermedia* Du Plessis, *O. circinnata* Cal., and *O. setosa* Du Plessis.

New Species of Echinostoma in Dog.‖—A. Railliet and A. Henry describe *Echinostoma gregale* sp. n. (a small Trematode, 2–3 mm. in length) found abundantly in the intestine of two dogs.

Distomum Larvæ in a Caterpillar.¶—O. von Linstow describes under the name *Distomum hydrocampæ*, a larval form obtained in the aquatic caterpillar of *Hydrocampa nymphæata*. It is the first record of a *Distomum* larva in Lepidoptera. Lists of the Orthoptera, Neuroptera, and Diptera in which Distomids occur are given.

Larval Trematodes.**—W. Nicoll and W. Small describe cercariæ from *Carcinus mænas* and *Cancer pagurus*. which are undoubtedly the larvæ of some species of *Spelotrema*, probably *S. excellens* Nicoll. Another cercaria from *Lima hians* is the larva of a species of *Steringophorus* or of *Fellodistomum*. The larva of *Cryptocotyle concava* was found in the plaice, and that of *Stephanochasmus baccatus* Nicoll in *Pleuronectes limanda*.

* Parasitology, i. (1908) pp. 263–79.
† Zeitschr. wiss. Zool., xci. (1908) pp. 279–303 (1 pl.).
‡ Arkiv Zool., iv. (1908) No. 7, pp. 1–11.
§ MT. Zool. Stat. Neapel, xviii. (1908) pp. 644–50 (12 figs.).
‖ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 447–9.
¶ Centralbl. Parasitenk,, xlix. (1908) Abth. i., pp. 331–3 (1 fig.).
** Ann. Nat. Hist., iii. (1908) pp. 237–46 (2 figs.)

Determination of Human Entozoa.*—Henry B. Ward deals especially with the Trematoda, such as *Cladorchis watsoni*, *Fasciola gigantica*, *Fasciolopsis buskii*.

New Intestinal Trematode of Man.†—Philip E. Garrison describes *Fascioletta ilocana* g. et sp. n., a small fluke, 4–6 mm. in length, from the intestine of Filipinos. In addition to its small size, the new parasite is remarkable for the large prominent ventral sucker, and for the general contour of the body, which is broadest in the region of the acetabulum, and tapers posteriorly throughout fully two-thirds of its length.

Tapeworms in Grouse.‡—A. E. Shipley discusses *Davainea urogalli* Modeer from the small intestine of the grouse. "It frequently protrudes from the hinder end of the alimentary canal and sometimes trails like a pennant behind a bird that is flying." He has not found that it causes serious trouble, but a closely allied species, *D. echinobothrida*, causes the so-called "nodular disease" of the intestine so fatal to poultry.

A second tapeworm in the grouse is *Hymenolepis microps* Diesing, which lives in countless numbers in the duodenum, though unrecognisable when alive. It is quite transparent, but if corrosive sublimate be added, it appears as a fine opaque thread, sometimes 15 cm. in length, with a large number of proglottides.

Triænophorus nodulosus.§—A. E. Shipley records the larval form of this tapeworm from the liver of a perch caught in the Norfolk Broads. Cysts of this larva have been found in the pike (the normal host of the adult), in the grayling, trout, salmon, and pope-fish. Some of the larval forms attain a surprising length. Ordinarily from one to three centimetres long, they have been found encysted in the tail muscles, eight, fifteen, and even twenty-five centimetres in length.

New Species of Ichthyotænia.‖—C. Barbieri describes *Ichthyotænia agonis* sp. n., found very abundantly in pyloric cæca of *Alosa finta* var. *lacustris*. On an average there were 1400 parasites in each fish. Yet there seemed to be no resulting mortality. There are some reasons for believing that acephalocystic larvæ found in the crustaceans *Bythotrephes* and *Leptodora* are the young stages of this new species of *Ichthyotænia*.

Cestodes of the Dry Tortugas.¶—Edwin Linton reports on numerous Cestodes, including a new genus, *Pedibothrium*, represented by three species in the nurse-shark, and a new species of *Acanthobothrium*, *Rhinebothrium*, and *Rhynchobothrium*. In *Pedibothrium* the body is tenuiform, articulate, with the head separated from the body by a distinct neck, and provided with four distinct, cruciform, armed

* Trans. Amer. Micr. Soc., xxviii. (1908) pp. 177–200 (1 pl.).
† Philippine Journ. Sci., iii. (1908) pp. 385–92 (2 pls.).
‡ Parasitology, i. No. 4 (1908) pp. 263–79.
§ Tom. cit., pp. 281–2 (1 fig.).
‖ Centralbl. Parasitenk., xlix. (1909) Abth. i., pp. 334–40 (8 figs.).
¶ Publications Carnegie Institution, Washington, No. 102, pp. 157–90 (11 pls.).

bothria, without auxiliary suckers, costæ or loculi. Each bothrium is strengthened by a strong muscular ring, with a thin, more or less leaf-like border, and is armed at the anterior end with a pair of compound hooks. Each hook consists of two unequal prongs, which rise from a flattened base. This basal part of the hook has a characteristic shape in each species. The neck is traversed by conspicuous bundles of longitudinal muscle-fibres. This new genus is separated from *Acanthobothrium* by the absence of costæ, and from *Phoreiobothrium* by the character of the hooks, which have two instead of three prongs, and further by the absence of loculi on the bothria.

Anonchotænia.*—O. Fuhrmann discusses this Cestode genus which has many representatives in Passerine birds. There is no rostellum, the jointing of the strobila is subsequent to the establishment of the gonads, the genital apertures are regularly alternate, and there are distinctive peculiarities in the reproductive organs. Fuhrmann describes eight species, of which four are new.

Development of Prosorochmus viviparus.†—W. Salensky has studied the embryos of this Nemertine, with special reference to some disputed points. The mesoderm is traceable to primitive mesoblast-cells, appearing near the blastopore, and probably also to mesenchyme. The whole nervous system arises from a single primordium—two lateral thickenings of ectoderm dorsal to the blastopore. Each primordium differentiates into a dorsal and ventral portion, forming the respective ganglia, and the lateral nerves arise as extensions from the ventral ganglia. In the embryo, as also in the adult, there is a cœlom, represented by a dorsal cavity (the proboscis sheath) and two lateral cavities (due to the partial splitting of the mesodermic pleural-layer), in which the lateral nerves lie. The proboscis has no share in the formation of the œsophagus; the two structures are primarily quite distinct; the atrium of the proboscis, however, is at once part of the proboscis and part of the œsophagus.

Incertæ Sedis.

Fertilisation and Development in Orthonectids.‡—M. Caullery and A. Lavallée have studied *Rhopalura ophiocomæ*, and find that the phenomena of maturation and fertilisation are closely comparable to those in Metazoa. There is a reduction in the number of chromosomes like that in *Ascaris megalocephala*, there seem to be tetrads formed, and so on. The embryo is definitely cellular, in contrast to the plasmodial later stages. Many facts set forth in the memoir point to the conclusion that the Orthonectids are organisms derived from higher forms, that have been simplified as regards their vegetative organs and differentiated as regards their reproductive system, both changes being related to their parasitism.

* Centralbl. Parasitenk., xlvi. (1908) Abth. i., pp. 622–31 (16 figs.).
† Bull. Acad. Imp. Sci. St. Petersbourg, 1909, pp. 325–40 (9 figs.).
‡ Arch. Zool. Exper., viii. (1908) pp. 421–69 (1 pl. and 7 figs.).

Bryozoa from the Sudanese Red Sea.*—A. W. Waters reports on the collection of Bryozoa made by Cyril Crossland in the Sudanese Red Sea. He calls attention to the very wide distribution of many species of tropical Bryozoa; to the great variety of structure to be found in the oral glands, which also show striking similarity in certain groups; to the number of characters that influence the structure of the operculum; and to many other points of interest.

Echinoderma.

Australian and Indo-Pacific Echinoderms.†—H. L. Clark reports on the Australian material in the Museum of Comparative Zoology, Harvard. He discusses, among others, the Ophiuroid genera *Ophiarachna* and *Ophiopeza* (the latter becoming a synonym of *Pectinura*). He gives keys for the species of *Pectinura*, *Ophiarachnella*, etc., and establishes as new Ophiuroid genera *Bathypectinura*, *Cryptopelta*, and *Conocladus*. An interesting Echinothurid, *Asthenosoma thetidis* sp. n., is described.

Movements of Starfishes on the Shore.‡—G. Bohn has studied the movements of *Asterias rubens*, which ascends and descends on the shore. He says that it exhibits a "geotropoism" alternately negative and positive. But changes in the illumination, the degree of oxygenation, and the pressure, may disturb the "geotropism"—altering the sign.

Glands of Ophiuroids.§—A. Reichensperger finds that the luminescence of *Ophiopsila annulosa* and *Amphiura filiformis* is due to special glandular cells and cell-masses. The cells are large, with granular and mucous contents and a distinct nucleus. They send long processes into the epithelium; in *Ophiopsila* fine canals penetrate the cuticle. In *Amphiura filiformis* there are in the vicinity of the gland-apertures fine cuticular rods into which nerve fibrils extend. Glandular cells, with very peculiar nuclei, occur in *A. squamata* in the calcareous matrix near the base of the tube-feet, but they have not to do with the luminescence. The tube-feet of *A. squamata* showed no luminescence.

It seems that the luminescence is strictly intracellular or intraglandular. In many species the tube-feet have glands, whose secretion helps in locomotion, but in species that move by jerks these glands are few or absent. In a large number of Ophiuroids the tube-feet are locomotor, in others they are mainly sensory. In *Ophiomyxa* there are numerous protective glands over the whole surface.

Cœlentera.

Alcyonarians from Gulf of Cutch.‖—J. Arthur Thomson and G. Crane report on a collection of Alcyonarians made by Hornell in shallow water in the Gulf of Cutch. Specimens of *Dendronephthya*, better known as *Spongodes*, of *Lophogorgia*, and *Astromuricea*, can be

* Journ. Linn. Soc. (Zool.) xxxi. (1909) pp. 123–81 (9 pls.).
† Bull. Mus. Comp. Zool., lii. (1909) pp. 109–35 (1 pl.).
‡ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 444–6.
§ Zeitschr. wiss. Zool., xci. (1908) pp. 304–50 (2 pls. and 5 figs.).
‖ Ann. Nat. Hist., iii. (1909) pp. 362–6.

collected at low tide. The collection includes eight species, one of which, *Astromuricea stellifera*, is new. There is also a new variety of a remarkable species of *Echinomuricea*, previously found in the Indian Ocean.

Hydroids of Behring Sea.*—E. Jäderholm reports on a number of hydroids from Behring Sea, including *Lafoëa fruticosa*, *Halecium telescopicum*, *Abietinaria gigantea*, *Grammaria immersa*, and *Selaginopsis cylindrica*.

Autotomy of Hydranth of Tubularia.†—Max Morse finds that colonies of *T. crocea* brought into aquaria lose their hydranths, which are pinched off and disintegrate. New hydranths replace the old ones. The influence of illumination, oxygenation, currents, etc., has been studied, and the author finds that temperature seems to be the only consistent factor involved in the decapitation. When the temperature is kept about 10°–15° C. the hydranths are retained.

Cladocarpus formosus.‡—James Ritchie has a note on this rare Plumularian, which Allman described in 1874, from the Faëroe Channel. Fresh specimens have been obtained from the same place. Some additional information and corrections of some details in Allman's description are given. It is noted that "*C. formosus*," of the 'Challenger' Report, is really a variety of *C. crenatus*, and that *C. crenulatus* Levinsen is the same as *C. formosus*.

Protozoa.

Wagnerella borealis.§—Margarete Zuelzer has studied this interesting type, with its conical base, long stalk, and spherical head. There are minute crescent-shaped needles of silica in the rather rigid base and stalk, and the same, along with large loosely connected needles in the head. There are numerous needles in the protoplasm beneath the delicate elastic pellicle. The pseudopodia stream out from the loose framework of the head, and show great sensitiveness. In the centre of the head there is a strongly refracting spherule, which can pass along with the head protoplasm into the shelter of the stalk. There is multiplication by fission, by budding, and by spores. Conjugation of spores was not observed, but it probably occurs. There is an alternation of generations.

Foraminifera of Woods Hole.‖—Joseph A. Cushman records 28 species in 16 genera. The shallow, sheltered area, with a bottom in many parts of shifting sand, is not favourable to Foraminifera. Most of the species are those which are common also in the littoral zone of the European coast of the North Atlantic.

* Archiv Zool., iv. (1908) No. 8, pp. 1–8 (2 pls.).
† Biol. Bull., xvi. (1909) pp. 172–82 (2 figs.).
‡ Ann. Nat. Hist., iii. (1909) pp. 310–14 (2 figs.).
§ SB. Ges. Nat. Freunde Berlin, 1908, pp. 151–6 (1 pl.).
‖ Proc. Boston Soc. Nat. Hist., xxxiv. (1908) pp. 21–34 (1 pl.).

Dimorphism and Fusion in Fusulinids.*—Hans v. Staff discusses the pronounced dimorphism in *Fusulina* and other forms, regarding the macrosphæric generation as probably asexual, and the microsphæric as sexual. He also discusses the fusion of very young stages in Fusulinids.

Intracellular Agglutination in Pelomyxa.†—A. Stolc gives reasons for believing that *Pelomyxa* produces intracellular agglutinins and lysins, and that the same is true of amœbæ and other Protozoa. Like the making of ferments, so the making of agglutinins and lysins is a fundamental property of the cell.

Amœba of Dysentery in Cochin-China.‡—F. Noc finds that there is an amœba commonly associated with abscess of the liver and dysenteric ulcers. It is also found in the drinking-water and in vegetables gathered from the surface of the ground. It bears some resemblance morphologically to *Entamœba histolytica*.

Habits of Didinium nasutum.§—S. O. Mast describes the reactions of this Ciliate protozoon, with special reference to the feeding habits, and the functions of the trichocysts. The organism is approximately ellipsoidal in form, slightly flattened at the anterior end. From this end there arises an apparently fibrous conical projection, at the apex of which the mouth is situated. The protuberance contains numerous rod-like structures, and the whole forms a "seizing organ." When *Didinium* comes in contact with an organism it usually responds with the avoiding reaction, always turning towards the same side, in spite of the fact that it is radially symmetrical. It feeds entirely on living organisms, principally *Paramœcium*. It captures these organisms by coming in contact with them in swimming about at random. The prey is held by means of the seizing organ, which in some way adheres to the surface with which it comes in contact.

There are no trichocysts discharged from the *Didinium*: these come from the victims. The seizing organ is not thrust out at the victim, nor is the prey paralysed by poison injected through this organ. The trichocysts function as organs of defence. They are discharged in great numbers when the seizing organ fastens itself to the ectosarc. This forces the aggressor back mechanically, and frequently breaks the connection, so that the victim regains its freedom.

Well fed specimens of *D. nasutum* continue to divide for some time without food, becoming smaller and smaller until they are not more than one-tenth of the original size. Encysted forms are frequently found. The chemical composition of the solution in which they live seems to cause them to encyst, rather than lack of food, as maintained by Thon. The apparent choice of food is due to the fact that the seizing organ will adhere to the surface of some organisms and not of others. The Infusorians come in contact with all sorts of objects in their random swimming, and attempt to swallow all those to which the seizing-organ will adhere.

* SB. Ges. Nat. Freunde Berlin, 1908, pp. 217–37 (13 figs.).
† SB. k. Böhm. Ges. Wiss., 1908, No. 5, pp. 1–5.
‡ Ann. Inst. Pasteur, xxiii. (1909) pp. 177–204 (4 pls.).
§ Biol. Bull., xvi. (1909) pp. 99–118 (18 figs.).

Frontonia leucas.*—Abraham Brodsky has made a detailed study of this Ciliate. The ectoplasm includes not only homogeneous and alveolar layers, but also a granular layer composed of spherical granules imbedded in the homogeneous plasm and covering the whole surface. Both in cytoplasm and nucleoplasm there is an alveolar basis and granules. In the micronucleus the alveoli are most minute. The trichocyst is highly differentiated, showing head, neck, and body. Its explosion is the result of a chemical reaction produced by the entrance of water. The buccal structures show a combination of Trichostome and Gymnostome features. There are two oral membranes, of which the larger is undulatory. The buccal cavity and gullet are surrounded by strong rodlets.

The numerous micronuclei are lodged in deep pockets in the membrane of the macronucleus. The mass of cytoplasm is almost strictly proportional to the mass of nucleoplasm. During its division the macronucleus passes through stages parallel to those in the division of the micronucleus. Its substance differentiates into chromatin and linin.

Infusorians in Holothurians.†—P. de Beauchamp reports that he found at Banyuls in the respiratory tree of *Cucumaria planci*, the two interesting Infusorians which Stevens found in *Holothuria californica* from the Gulf of California, viz.: *Licnophora macfarlandi* and *Boveria subcylindrica*.

Studies on Volvox.‡—J. H. Powers describes *Volvox spermatosphara* sp. n., *V. weismannia* sp. n., and *V. perglobator* sp. n. It is possible to arrange the known species in a series:—*V. spermatosphara*, lowest because of its *Eudorina*-like sperm-spheres, its lack of cytoplasmic cell-connections, its small size, etc.; just above it *V. weismannia*; then *V. tertius*, *V. aureus* (*minor*), *V. globator*, and highest of all *V. perglobator*. "The detailed phenomena of reproduction in *V. spermatosphara*, and still more in *V. weismannia*, seem to yield strong support to the hypothesis that nutritive causes, manifesting themselves especially in the size of the cells, are an important factor in determining the sex of the reproductive cells or their products in these incipient multicellular organisms."

Macronucleus of Ciliata.§—E. Fauré-Fremiet has used the "ultramicroscope" in studying the structure of the macronucleus. It is full of refractive microsomes very close together. When a solution of soda is added these granules disappear. The macronucleus behaves like a negative colloidal solution with closely approximated granules. Its structure depends on the reaction of the medium surrounding it.

New Species of Chilodon on Fishes.‖—E. Kiernik describes *Chilodon hexastichus* sp. n., an Infusorian found on tench, carp, and

* Rev. Suiss. Zool., xvi. (1909 pp. 75–130.
† Bull. Soc. Zool. France, xxxiv. (1909) pp. 6–7.
‡ Trans. Amer. Micr. Soc., xxviii. (1908) pp. 141–75 (4 pls.).
§ Bull. Soc. Zool. France, xxxiv. (1909) pp. 55–6 (1 fig.).
‖ Bull. Internat. Acad. Sci. Cracovie, 1909, pp. 75–119 (3 figs.).

other freshwater fishes. He gave a detailed account of the minute structure of the animal, and discusses in particular the formation of vacuoles, the mechanism of their emptying, the nucleus, the conjugation, and the division. In the strict sense, perhaps, *Chilodon hexastichus* is rather symbiotic than parasitic. It lives on the fishes because it finds appropriate nutriment, probably of a very special sort. In normal conditions it occurs on the fish in small numbers, and may be useful in devouring and destroying the bacteria on the fish. It may be, however, that its prolific multiplication when there is a strong bacterial infection may lead to the more rapid death of the fish by suffocation.

New Leptomonad in Muscids.*—E. Roubaud describes *Leptomonas mesnili* sp. n., from the posterior intestine of two species of *Lucilia* from Brazzaville. It is closely allied to *L. mirabilis*, and has propagative trypanosome forms, furnishing additional evidence that *Trypanosoma* and *Leptomonas* cannot be separated.

Microsporidian parasitic in a Gregarine.†—L. Léger and O. Duboscq describe *Nosema frenzelinæ* sp. n., which lives in the cytoplasm of a polycysted Gregarine, *Frenzelina conformis* Dies., a parasite of a crab (*Pachygrapsus marmoratus*). The microsporidian abounds in the cytoplasm of conjugated and encysted Gregarines, and seems somehow to prevent the formation of gametes. It has an effect like parasitic castration. The parasite sporulates within its host, and the Gregarine cyst becomes a microsporidian cyst.

Position of Spirochæta.‡—R. Gonder discusses this vexed question, and comes to the conclusion that the Spirochæts should be regarded as a special order in the group of Flagellata, and, as Hartmann proposes, in the vicinity of the Trypanosomes. The locomotor apparatus in Trypanosomes—blepharoplast with flagellum and undulating membrane—is not essentially different from the undulating membrane with marginal filament and basal corpuscles in Spirochæts. The nuclear apparatus is, of course, very different. Some notes on *Spirochæte pinnæ* are contributed.

* C.R. Soc. Biol. Paris, lxiv. (1908) pp. 39–41 (11 figs.).
† Comptes Rendus, cxlviii. (1909) pp. 733–4.
‡ Centralbl. Parasitenk., xlix. (1909) Abth. i., pp. 190–6 (2 pls.).

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Chromosomes of Marchantia.*—J. H. Schaffner has examined the antheridiophores of *Marchantia polymorpha*, and finds centrosomes in the antheridial cells of all stages. At the commencement of nuclear division, cytoplasmic radiations are to be seen on opposite sides of the nucleus; the centres of these radiations are the poles of future spindles. In later stages asters are ill-developed, while in earlier generations they are very conspicuous. The centrosomes are often surrounded by a hyaline zone, and the aster forms a cloud-like halo. The centrosome seems to enlarge in the grandmother-cells, and in the last division is very clear and still more enlarged. The chromosomes of the gametophyte are eight in number. After the final division the chromosome is an oval, dark-staining body giving rise to flagella. The author concludes that "the blepharoplast of *Marchantia* is only a slightly modified centrosome" traceable through many cell-generations, and probably present through the entire ontogeny.

Amitosis in Synchytrium.†—R. F. Griggs has examined nuclear division in *Synchytrium*, and finds that the numerous peculiarities occur immediately after the division of the primary nucleus. Direct division of the nucleus occurs more frequently than mitosis, and is by at least two processes, viz.—(1) nuclear gemmation, in which the nucleolus separates off a small nucleolus, which passes through the nuclear membrane, surrounds itself with a membrane, and forms an independent small nucleus; (2) heteroschizis, in which the nucleus dissolves and the nucleolus breaks into many pieces, each becoming a new nucleus, eventually forming "a morula-like cluster of nuclei." The nuclei thus formed eventually undergo mitosis, and their descendants form spores. The number of chromosomes in the nuclei appears to be constant.

Structure and Development.

Vegetative.

Thylose-formations.‡—H. von Alten has studied thyloses in *Manihot*, *Ficus*, etc., and draws the following conclusions from his observations. There are two groups of thyloses, distinguished by having a simple or compound membrane. The form and size are

* Ohio Nat., ix. (1908) pp. 383–8 (1 pl.).
† Bot. Gaz., xlvii. (1909) pp. 127–38 (2 pls.).
‡ Bot. Zeit., lxvii. (1909) pp. 1–23 (1 pl. and 4 figs.).

dependent upon the width and walls of the vessel. Distinction must be clearly drawn between (1) thyloses due to wounding, which are sometimes found in plants, where they do not occur normally, and which only perform the role of preventing the drying-up of the wall of the vessel, and (2) those normal thyloses due to the outgrowth of the pit-membrane, which diminish the breadth of the vessel, thus increasing capillarity and promoting the rise of water. Thyloses are often used in connection with the storage of starch, and they may act as haustoria in removing certain nourishing salts from the water; further, they assist in bringing certain carbohydrates into solution. The author considers that physical factors are the cause of thylose-formation, and disagrees with those writers who refer them to chemical causes. There is no support for those who regard them as unicellular, for in large vessels, especially in the roots, division-walls have been seen. The thyloses of the roots are first formed in the youngest parts, while in the stem they are first formed in the older vessels. In both cases their presence depends upon certain anatomical and biological conditions.

Phylloclades of Ruscus.*—J. Bernatsky has examined the phylloclades of *Ruscus*, and finds that at the base is a central cylinder consisting of several vascular bundles, the xylem of which is centrally directed. In the upper part the central cylinder is merged into several smaller cylinders having a similar orientation of xylem and phloem. The portion which bears the inflorescence possesses not only single vascular bundles but also a small central cylinder composed of two bundles, which also have their xylems turned towards one another. Thus the phylloclade must be a "caulome," for a central cylinder is never found in any part of a leaf.

Reproductive.

Embryo-formation of Gunnera.†—J. Modilewski has studied the embryo-sac formation of *Gunnera chilensis*, and finds that the archesporial cell develops directly into an embryo-sac without any intermediate divisions. The first nucleus of the embryo-sac divides regularly four times to form sixteen nuclei, four of which are in the micropylar end and the remaining twelve in the antipodal end of the embryo-sac. The ripe embryo-sac consists of a normal egg-apparatus, six antipodals, and a cluster of central nuclei, which fuse to form a large secondary embryo-sac nucleus. There is no suspensor, and the embryo is imbedded in much endosperm. Embryo-formation is probably parthenogenetic.

Fertilisation of the Poppy.‡—P. Becquerel has studied the fertilisation of two varieties of Poppy, viz. Mephisto and Danebrog. The experiments were carried out upon two groups of buds—the first comprising unopened buds with bent peduncles, and stamens not yet open; the second group included older buds, where the peduncles were

* Math. u. Naturwiss. Ber. Ungarn, xxi. (1907) pp. 113–18. See also Bot. Zeit., lxvii. (1909) p. 23.
† Ber. Deutsch. Bot. Gesell., xxvi*a* (1908) pp. 550–5 (1 pl.).
‡ Comptes Rendus, cxlviii. (1909) pp. 357–9.

beginning to straighten themselves and the stamens were dehiscing. Some specimens of both groups were left exposed to the visits of bees, while others were protected by means of coverings of muslin. The same results were obtained in each group both with covered and exposed flowers, for the bees ceased their visits as soon as they discovered the absence of stamens. In the first group the fruit developed parthenogenetically, and the ovules inclosed were dry and never formed seeds. In the second group both fruit and seeds were well developed, proving that fertilisation takes place within the bud at the moment when the peduncle begins to straighten itself.

Floral Anomaly in Doronicum.*—J. W. Palibine has examined some anomalous flowers of *Doronicum*, in which a second inflorescence was formed at the summit of the normal capitulum. This second inflorescence consisted of tubular florets surrounded by strap-like florets of smaller size. The strap-like florets have lobed corollas. The involucral leaves of this abnormal inflorescence are arranged in an opposite manner to those of the normal capitulum, and are shorter and thinner, besides being slightly different in general structure. The author considers that these abnormalities are the expression of certain latent characters which only develop under particular conditions.

Physiology.

Nutrition and Growth.

Grafting of Perennial upon Annual Plants.†—L. Daniel contributes a short note dealing with the results of grafting the potato upon the tomato and perennial sunflowers upon the annual sunflower. The graft and the host react in a curious way upon one another, for the former not being able to form the usual underground tubers, often forms aerial ones; the host being unable to make use of these reserve materials in the ordinary way, utilises them in the formation of abnormal ligneous tissues. These results were uniformly obtained in all the experiments on sunflowers, and frequently, but less uniformly, in those performed with the potato and tomato.

Amylase in Old Seeds.‡—Brocq-Rousseu and E. Gain contribute a note relating to a few experiments made upon old wheat seeds. The latter were about fifty years old, and were no longer capable of germinating. In spite of this they still contained dextrinase and amylase capable of converting starch into sugar. The experiments do not prove whether the diastatic action preserves its initial intensity, but they confirm the fact that the power of germination is not exclusively connected with the preservation of diastatic properties.

Respiration of the Stamens and Pistil.§—G. Maige has experimented upon *Verbascum*, *Lavatera*, *Acanthus*, *Antirrhinum*, etc. with special reference to the respiration of the stamens and pistil. Her

* Arch. Sci. Phys. Nat. Genève, xxvii. (1909) pp. 69–76 (1 pl. and 1 fig.).
† Comptes Rendus, cxlviii. (1909) pp. 431–3.
‡ Tom. cit., pp. 359–61. § Rév. Gén. Bot. xxi. (1909) pp. 32–8.

results, which confirm those obtained by De Saussure, are as follows:—The respiratory quotient of the reproductive organs is much greater than that of the leaves. The respiratory quotient of the pistil is usually greater than that of the stamens; in the plants examined *Canna indica* was the only exception. The respiratory intensity of the anther is greater than that of the filament. The intramolecular respiratory intensity is usually greater in the reproductive organs than in the leaves; *Lavatera Olbia* forms an exception, and in *Cheiranthus Cheiri* and *Tropæolum majus* there is very little difference between the respiration of the stamens and pistil and that of the leaves. The intramolecular respiratory intensity of the pistil is again greater than that of the stamens, with the exception of *Acanthus*; in *Ornithogalum arabicum* the two intensities are about equal.

Irritability.

Chemotaxis of Spermatozoids of Lycopodium.*—H. Bruchmann has made experiments upon the spermatozoids of *Lycopodium*, and concludes that they are attracted to the archegonia by the chemotactic action of free citric acid or of solutions of several of its salts. Although it is impossible to detect the acid in the contents of the archegonium or the neighbouring cells, the sap of the prothallium is weakly acid. The presence of the acid is probably due to the saprophytic mode of life of the prothallus, and perhaps to the presence of an endophytic fungus; it appears to form a protection against the attacks of insects, but to be the means of bringing about fertilisation. Spectrum-analysis confirms the presence of the acid.

Hygroscopic Movements of Leaves.†—W. Lorch replies to a remark made by Steinbrinck in his paper on the mechanism of cohesion in the rolling and folding leaves of *Polytrichum commune* and of certain dune-grasses.‡ Lorch maintains, in opposition to Steinbrinck, that there is in the leaves of *Polytrichum commune* a mechanically weaker part which acts as a sort of joint, and that it is situated in the median line of the dorsal sclerenchyma plate. And he disagrees with Steinbrinck in several other points.

General.

Castration in Zea Mays produced by Ustilago.§—M. Chifflot publishes a note describing observations made upon "parasitic traumatism" in connection with *Zea Mays*. The female and hermaphrodite flowers of inflorescences attacked by the fungus have much modified stamens. Even when the latter appear to be normal externally, it is found that the pollen is often not shed, and the grains themselves are greatly modified in structure. In the hermaphrodite flowers the ovary never attains maturity. The purely female flowers undergo no reduction and yield perfect seeds. In conclusion, the author states his belief that traumatism, however caused, produces thelygenous castration, and that Laurent's theory respecting these anomalies is perfectly admissible.

* Flora, xcix. (1909) pp. 193–202 (1 fig.).
† Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 51–6.
‡ Op. cit., xxvi. (1908) pp. 399–412.
§ Comptes Rendus, cxlviii. (1909) pp. 426–9.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

Phylogeny of the Pteridophyta.*—I. Browne publishes her seventh article upon the phylogeny and inter-relationships of the Pteridophyta. and considers the inter-relationships of the phyla in considerable detail, summarising the conflicting views of various writers upon the subject, for instance, Tansley, Campbell, Lang, Bower, Jeffrey, Lignier, Scott.

Alternation of Generations based on Ontogeny.—W. H. Lang expounds a theory of alternation of generations in archegoniate plants based upon the ontogeny. The development of an organism from the germ-cell is regarded as due (*a*) to the properties of the germ-cell, and (*b*) to the conditions under which the germ-cell develops. Each stage of development influences the succeeding stage. Each specific germ-cell develops under normal conditions into its corresponding specific form of the plant. In certain algæ (*Dictyota*, *Polysiphonia*) there is an alternation of generations distinguished only by the number of chromosomes in the nuclei and by the reproductive organs: and the two generations are strictly homologous. In the Bryophyta and Pteridophyta there is also a regular alternation of generations very dissimilar in their form and structure, apart from the nature of the reproductive organs and the number of chromosomes. The explanation of the great difference between the two generations is to be sought, not in the cytological differences between the two sorts of germ-cells, but to the very different conditions under which they develop. It is assumed that the haploid and diploid germ-cells have potentially the same morphogenetic properties and under the same conditions would give rise to similar bodies. The spore, however, develops free, in direct relation to the soil, water, light, etc. The fertilised egg, on the other hand, develops under the protection of the maternal plant-tissues, under their nutritive and stimulating influences. In the Bryophyta the maternal influence and protection last throughout the development of the sporogonium. In the Pteridophyta the young sporophyte after a while becomes free from the prothallus; but the lines of development initiated under the influence of the parent-prothallus determine the further course of development. In the flowering plants the case is reversed, and it is the gametophyte which develops within the body of the sporophyte. In these cases of parental association it is to be noted that the nursed organism produces an effect upon the tissues inclosing it; for instance, the calyptra that grows up around the young sporogonium in *Aneura* or *Anthoceros*, and perhaps the coats of the ovule and seed. As regards the phylogenetic problem of the origin of the two generations in the Archegoniatæ, the origin is to be sought in some ancestral algæ with a haploid or sexual and a diploid or asexual generation of similar form and of alternating recurrence. The

* New Phytolog., viii. (1909) pp. 51–72. † Tom. cit., pp. 1–12.

change from the extruded ovum to the fertilised egg which is retained within the parental body and is submitted to the physiological influence of the maternal tissues—a change which probably coincided with or resulted from the change to a terrestrial life—opened up possibilities for profound changes and developments, resulting in the difference in body form between sporophyte and gametophyte. The Bryophyta and Pteridophyta may have had quite independent origin from different sets of organisms at the same or at different geological periods. Indeed, the main groups of the Pteridophyta, such as Lycopodiales and Filicales, may have started on different lines. The dispersal of the plant is assumed to have been insured by the free shedding of air-borne spores. The two generations in each species are regarded as homologous. The number of chromosomes and the mode of reproduction are assumed to have been different in the two generations of the ancestral forms. The further evolution of the organisms would have involved the occurrence of variation and selection. The consequent changes may have been manifested in either or both generations, depending on the conditions. The sporophyte may have advanced while the corresponding gametophyte remained unaltered. The author briefly applies his hypothesis to the three great groups—Ferns, Lycopods, Equisetaceæ.

Alternation of Generations.*—W. H. Lang's exposition of his ontogenetic theory of the alternation of generations before the Linnean Society, on February 18th, is reported almost verbatim, together with the criticisms offered by F. O. Bower, D. H. Scott, J. B. Farmer, F. W. Oliver, and A. G. Tansley.

Water-cavities of Equisetum.†—J. H. Schaffner contributes a note upon a condition noticed during winter in *Equisetum hyemale*. The vallecular, carinal, and central cavities were found to be filled with ice. Portions of the plants were taken indoors and placed under observation, when it was found that the water which resulted from melting the ice, disappeared more or less rapidly in proportion to the size of portion of stem, those including a portion of the rhizome retaining the water for the longest period. Observations made in May upon other species of *Equisetum* showed no free water in any of the cavities. The water present during winter appears to have some physiological connection with the plant in relation to extreme cold.

Ferns of the Vosges.‡—E. Walter calls attention to the occurrence of *Aspidium aculeatum* in the Vosges Mountains, points out the characters which separate it from *A. lobatum*, and sketches out the geographical distribution of the two species.

The same author § gives an account of the ferns on the sandstone in the neighbourhood of Zabern in the Vosges. Several ferns of southern

* New Phytologist, viii. (1909) pp. 104–16.
† Ohio Nat., ix. (1908) pp. 393–4.
‡ Mitt. Philom. Gesell. Elsass-Lothringen, iii. (1907) pp. 455–60 (pl.).
§ Tom. cit., pp. 547–81 (figs.).

and western type occur here, though absent or rare in the rest of the Vosges. Many new stations for the species and forms are revealed by the author.

Ferns of the Canary Islands.*—J. Pitard and L. Proust give an account of the ferns of the Canaries with the distribution of each species within the archipelago. They enumerate forty ferns and three fern-allies.

New Hybrids of Dryopteris in North America.†—R. C. Benedict gives an account of some new hybrids of *Dryopteris* in the United States. Eleven hybrids had previously been reported in the country—one in *Asplenium*, one bigeneric and compounded of *Asplenium* and *Camptosorus*, and the remaining confined to the genus *Dryopteris*. Six species of *Dryopteris* appear to hybridise more or less readily with one another, viz., *D. Clintoniana*, *D. cristata*, *D. Goldiana*, *D. intermedia*, *D. marginalis*, *D. spinulosa*. Of these the possible number of pairs is fifteen; and nine of these have been made known by the researches of P. Dowell, M. Slosson, and others; four are described in the present paper; others are promised; and only one, *D. Goldiana* × *spinulosa*, remains to be discovered. The following features have to be closely studied in the discrimination of these hybrids: (1) intermediate character; (2) sterility, abnormality, and greater vigour; (3) distribution. 1. Such points as general habit of the plant, shape and cutting of the pinnæ, etc., scales of the stipes, cell structure and glandularity of the indusia, have to be taken into account. 2. Very rarely indeed have mature spores been found on the hybrids. Correlated with the sterility is usually a greater vegetative activity, the plants being larger, or the fronds abnormal and irregular. 3. As to distribution, the hybrids occur now and again in damp woods with the parent species. It is conceivable that the hybrids, owing to their great vigour, might survive the destruction of the parent species; and their establishment in a given locality would then appear difficult of explanation.

Ferns of Borneo.‡—E. B. Copeland publishes descriptions of new ferns collected in Borneo by Foxworthy, Hewitt, Brooks, and Young. *Macroglossum* and *Phanerosorus* are new genera. The former is allied to *Angiopteris*; and *Phanerosorus* is created for the reception of *Matonia sarmentosa* Baker. Thirteen new species are described.

New Species of Cyathea from Asia.§—E. B. Copeland describes seven new species of *Cyathea* collected in the Philippine Islands and the South of China. He discards as unsatisfactory the old division of the tree-ferns into three genera—*Cyathea*, *Hemitelia* (or *Amphicosmia*), and *Alsophila*—since the absence or presence of the indusium is inconstant. He therefore maintains only *Cyathea*.

New or Interesting Malayan Ferns.‖—C. R. W. K. Van Alderwerelt van Rosenburgh gives an account of some new or interesting Malayan

* Les Iles Canaries. Paris: Klincksieck, 1908, pp. 402–14.
† Bull. Torrey Bot. Club, xxxvi. (1909) pp. 41–9.
‡ Philippine Journ. Sci., iii. (1908) pp. 343–51 (8 pls.).
§ Tom. cit., pp. 353–7.
‖ Bull. du Dép. Agric. Indes Néerlandaises, xviii. (1908) 27 pp. (8 pls.).

ferns found in considerable numbers in the Buitenzorg Herbarium either unnamed or wrongly determined. He describes the novelties. The specimens were collected in Java, Sumatra, Borneo, Celebes, and other Malayan islands, and New Guinea. There are forty-nine new species and some varieties. Critical remarks are added to some of the older species.

In a second paper * he describes five more new species and some varieties.

Ferns of the Carboniferous Period.†—F. Behrend divides the Sphenopterideæ into Sphenopteroideæ and Ovopteroideæ, according to differences of venation. In the former group are *Cuneatopteris* and *Sphenopteris*; in the latter group are *Ovopteris* and *Ovopteridium*—a new genus.

Fern Bibliography for 1906.‡—C. Brick, of Hamburg, has published a classified bibliography of all references to ferns for the year 1906. It covers nearly a hundred pages, and treats of almost five hundred titles, arranged under ten headings, and supplemented by a list of all new species and varieties named in 1906.

Bryophyta.

(By A. Gepp.)

Germination and Sex in Sphærocarpus.§—C. Douin, in response to a request from Professor Strasburger, has conducted a series of experiments in order to determine whether in *Sphærocarpus* the four plants germinating from a given tetrad of spores are of different sex, whether two become male, and two become female. After pointing out how the male and female plants of *Sphærocarpus* may readily be distinguished, Douin gives an account of the observations he made of eighty-one little groups of plants collected at random at Chavannes. The results are divided into twenty cases ranged under three heads—(1) normal cases; (2) doubtful anomalies; (3) distinctly abnormal cases. 1. The normal cases were sixty-three, showing that, as a general rule, the four spores of a tetrad produce two male and two female thalli; and that, as the examined groups always consisted of four or eight thalli, the spores clearly remain as a rule united in tetrads until germination. 2. Anomalous cases thirteen, showing either that the tetrads became broken and the spores separated, or that some spores failed to germinate. 3. Four abnormal cases. Further, Douin shows that *S. terrestris* can readily be distinguished from *S. californicus* by comparatively longer male involucre.

Spore Formation and Nuclear Division in Mnium hornum.‖—M. Wilson gives an account of spore formation and nuclear division in *Mnium hornum*. 1. Fertilisation takes place during May; and early in the following January the single-celled archesporium can be recog-

* Bull. du Dép. Agric. Indes Néerlandaises, xxi. (1908) 9 pp. (4 pls.).
† Jahrb. k. Preuss. Geol. Landesanst., xxix. (1908) 52 pp. See also Bot. Zeit. 1909, 2te Abt., p. 70.
‡ Fern. Bulletin, xvii. (1909) pp. 31–2.
§ Rev. Bryolog., xxxvi. (1909) pp. 37–41 (figs.).
‖ Ann. of Bot., xxiii. (1909) pp. 141–157 (2 pls.).

nised. Spore formation and chromosome reduction are completed by about the middle of April. 2. In the resting nucleus is a large deeply staining nucleolus; the nuclear reticulum is very fine and contains little or no chromatin. 3. Each original archesporial cell gives rise to 8, 16 or 32 spore-mother-cells. As division approaches the nucleolus disappears, bands of chromatin are differentiated, and the spireme is formed. 4. The spireme divides transversely into twelve chromosomes of nearly equal size. No centrosomes are present. 5. The chromosomes split longitudinally, and the halves retreat from the equatorial plate towards the poles. The telophase is normal; several nucleoli are formed, but fuse into one. 6. The wall dividing the daughter-cells is formed at the equatorial plate. 7. The resting nucleus of the newly formed spore-mother-cell resembles that of the pre-meiotic cells, but contains more chromatin. A budding off from the nucleolus occurs. 8. The spireme then differentiates out slowly and gives rise to the first contraction figure. 9. On emergence the spireme is shorter and thicker; a network is formed and is followed by a second contraction, with loops in the spireme, which now shows traces of longitudinal fission. 10. The chromosomes are formed of local aggregations of chromatin and still show traces of longitudinal fission. They remain in the centre of the cell, while the nucleolus passes into the cytoplasm and soon disappears. 11. No centrospheres are found at the poles of the spindle. The chromosomes, six in number, become arranged on the equatorial plate, and show the characteristic O and X forms. They divide transversely and pass to the poles. 12. The homotype division results in the formation of four nuclei, which are later found in the spores.

Discharge of Antherozoids in Hepatics.*—A. S. Horne describes the discharge of antherozoids in *Fossombronia* and *Haplomitrium Hookeri*. He shows that the following processes take place during ripening of the antheridium:—1. Change in character of the chlorophyll corpuscules of the wall from above downwards. 2. Local degeneration of the middle lamella in the wall of the antheridium. Cell filaments are formed in *Fossombronia*. Special cells rise in *Haplomitrium*. 3. The upper wall-cells become free from the limiting membrane of the wall. When the antheridia are ripe, dehiscence takes place, the tense wall rupturing upon access of water.

Dislike of Sphagnaceæ for Lime.†—H. Paul discusses the cause of the dislike shown by Sphagnaceæ for lime. Despite what has been written about the matter, it is not calcium sulphate but calcium carbonate to which the Sphagnaceæ are so sensitive. The acidity of these mosses is greatest in those that are strictly confined to elevated moors, and least in those of the plains. The acid serves for dissolving nutritive substances. It is present in quantity where little air-borne nutritive matter reaches the plants; and such plants are very sensitive to the neutralisation of their acidity by lime. The acidity and the sensitiveness to neutralisation diminish in proportion as the amount of available mineral matter increases. *S. rubellum*, however, requires an

* Ann. of Bot., xxiii. (1909) pp. 159, 60 (figs.).
† Mitt. k. bayr. Moorkult. ii., pp. 63–118 (2 pls.). See also Hedwigia, xlviii. (1908) Beibl., p. 111.

appreciable amount of lime for its well-being, and yet it is a typical species of the high moors. As regards absorptive capacity for water, this is much more developed in the high moor species than in those of the plains.

Distichophyllum, a Genus New to Europe.*—H. N. Dixon gives an account of *Distichophyllum carinatum* Dixon and Nicholson, a new moss found by its describers on wet rocks above St. Wolfgang See, near Salzburg. The genus *Distichophyllum* has never before been gathered in Europe, and its geographical distribution is therefore discussed at considerable length. *D. carinatum* differs in certain respects from almost all species of the genus, its nearest ally being *D. cavifolium* Cardot, an Antarctic species. The explanation of the occurrence of *D. carinatum* in Europe is at present impossible. Only five species of the genus are found north of the Tropic of Cancer, and they are in Asia; but they exhibit no near affinity with *D. carinatum*.

Moss-distribution in Somersetshire.†—W. Watson gives an account of the distribution of the Bryophytes in the woodlands of Somersetshire. He divides the native woods into three categories according to the dominant element in their composition—oak-woods, ash-woods, oak-hazel-woods. The oak-hazel-woods occur on the Triassic and Jurassic marls and clays, the oak-woods at high elevations on the Sandstones, whilst the ash-woods are characteristic of the slopes of the Carboniferous Limestone. Some twenty-nine lichens are commonly found on the trees. Of the mosses the species most frequently met are pleurocarpous, of the hepatics the Jungermanniaceæ. The author gives a synoptical list showing the comparative frequency of the various species in the three types of native wood, together with several small lists of the species characteristic of the different types of wood, native or artificial.

Hepaticæ of Europe.‡—K. Müller publishes the seventh part of his Die Lebermoose in Rabenhorst's Kryptogamen-flora. He describes the species of *Fossombronia* and *Haplomitrium*, and thus brings to an end the Jungermanniaceæ Anakrogynæ. He then gives a general account of the Jungermanniaceæ Akrogynæ, with a key to the seven families; and starting with the Epigonantheæ, he begins to treat its genera one by one:—*Gymnomitrium*, *Marsupella* (unfinished). Keys, figures, explanatory diagrams, and critical notes characterise the work.

European Mosses.§—E. Bauer publishes some critical notes upon the eighth series of his Musci Europæi exsiccati, which contains fifty-seven specimens, including several originals. Some of them were collected in Sweden by Bomannsson, now deceased; and the supply of them is exhausted.

New and Rare British Muscineæ.—H. N. Dixon ‖ records the occurrence of *Encalypta ciliata* var. *subciliata* Warnst. among some mosses collected by G. Stabler in Aberdeenshire twenty-five years ago.

* Rev. Bryolog., xxxvi. (1909) pp. 21–6 (pl.).
† New Phytolog., viii (1909) pp. 90–6.
‡ Leipzig: Kummer, 1909, lief. 7, pp. 385–448 (figs.).
§ Allgem. Bot. Zeitschr., xv. (1909) pp. 17–18.
‖ Journ. of Bot., xlvii. (1909) p. 109.

The variety is not known to have been found elsewhere than in Tyrol and the Pyrenees. H. W. Lett * announces the discovery in Ireland of a moss, *Catharinea rhystophylla* C. Muell., hitherto known only as a native of North China. It was growing on the mud-cap of a stone wall in Co. Down, with *Ceratodon purpureus* and *Stereodon cupressiforme*. H. N. Dixon † records the finding by J. Hunter, of *Campylopus brevipilus* in fruit in North Donegal during July, 1907, and he describes the calyptra, operculum, etc. The species has only once previously been recorded in fruit; it was so found by E. Jörgensen on the Island of Stord, on the west coast of Norway. A. S. Horne ‡ records the discovery of the rare hepatic *Haplomitrium Hookeri*, near Budleigh Salterton, in Devonshire, in August and December, 1906. But since then he has been unable to find any more specimens in the same spot. D. A. Jones § records the first finding of *Riccia Crozalsii* in Britain, he and S. J. Owen having gathered it at Barmouth, associated with *R. glauca*, *R. sorocarpa*, *R. nigrella*, and *R. Lescuriana* on a mud-capped wall in September of last year. The plant was determined by S. M. Macvicar and M. Crozals. The original type of the species was found near Montpellier, in the south of France, and was described by E. Levier in 1902. A translation of Levier's diagnosis is given in the present paper, and some critical notes are added showing how the species differs from *R. ciliata*, *R. Michelii* var. *ciliaris* (= *R. tumida*), *R. Lescuriana* (= *R. glaucescens*). The species has been recorded from other places in the south of France, the north of Italy, Tyrol, and now from the Welsh counties Merioneth and Carnarvon. W. E. Evans ‖ records the discovery of *Physcomitrella patens* in reservoirs near Edinburgh, during a long period of drought. The plant was found in abundance associated with male plants of *Funaria hygrometrica*, and with *Riccia crystallina*. It is not known to have been gathered in Scotland previously.

North American Bryophyta.¶—A. Lorenz publishes some notes on *Cephaloziella myriantha* and *C. divaricata*, as found in New England. The two species have been confused; but *C. myriantha* is distinguished by having a paroicous inflorescence. She gives a history of the species, and shows how Schiffner came to the conclusion that the northern *C. myriantha* and the southern *C. Jackii* are one and the same species. She describes the habitat (dry rock), living appearance and morphology of *C. myriantha*. As to the other species, *C. divaricata*, she refers to the different opinions of European authors, and shows that Warnstorf split the species into two—*C. divaricata* and *C. byssacea*; and she cites Warnstorf's descriptions of those two species. Stephani and Massalongo agree with Warnstorf; but Schiffner holds different views. *C. divaricata* grows in damper, more shaded places, than does *C. myriantha*. E. G. Britton** publishes some notes upon the nomenclature of North American mosses based upon Brotherus' last contributions to the section of mosses in Engler's Pflanzenfamilien. J. D. Lowe †† gives a list of fifteen hepatics and forty-nine lichens collected in Nova Scotia at the narrowest part of

* Journ. of Bot., xlvii. (1909) pp. 109–10.
† Tom. cit., pp. 146–7.
‡ Tom. cit., p. 147.
§ Tom. cit., pp. 104–6.
‖ Annals Scottish Nat. Hist., No. 69 (1909) pp. 55–6.
¶ Bryologist, xii. (1909) pp. 25–7.
†† Tom. cit., pp. 38–40.
** Tom. cit., pp. 28–29.

Digby Neck, between the Bay of Fundy and St. Mary's Bay. A. W. Evans and G. E. Nichols * have prepared an enumeration of the Bryophytes of Connecticut, without descriptions, but with keys to the genera and species. There are 247 mosses, 31 Sphagnaceæ, and 92 hepatics. N. C. Kindberg † publishes some notes on North American Bryineæ, including descriptions of nine new species and varieties. Three species are new to North America ; eleven are new to Canada.

Bryophytes of the Canary Islands.‡—J. Pitard and G. Negri give an account of the moss-flora of the Canaries, with the distribution of each species within the Archipelago, and an indication of the plants found associated with it. They enumerate 120 species, and give a bibliography of previous literature on the subject.

J. Pitard and L. Corbière § supplement the above list with an enumeration of the hepatics, sixty-three species, treated in a similar fashion.

N. Bryhn ‖ publishes a list of 160 mosses and twelve hepatics, collected by him in Gran Canaria and Tenerifa. Twenty-six of the mosses are new to science or to the Canaries.

West African Mosses.¶—J. Cardot publishes a third article containing preliminary diagnoses of mosses from the Belgian Congo and West Africa. Nearly a score of descriptions with critical notes are given.

Mosses of China, Japan, and New Caledonia.**—I. Thériot publishes a sixth article upon mosses collected by French missionaries in the East, including one species from Japan, seventeen from China, and twenty from New Caledonia. These are all new species or varieties, and are described in Latin.

Bryophytes of New Caledonia.††—E. G. Paris reports on a fresh collection of mosses and hepatics received from New Caledonia. A new moss is described, and seven new hepatics are named. In hepatics New Caledonia is found by Stephani to be remarkably rich in endemic species.

Mosses of the Antarctic Regions.‡‡—J. Cardot's detailed report on the bryological flora of the regions of Magellan, South Georgia, and Antarctica has recently appeared in the report of the Swedish South Polar Expedition (1901–3). Owing to shipwreck part of the mosses were lost. From the residue Cardot determined some 200 species—137 for the Magellanic region, 80 for South Georgia, and 23 for the Antarctic region proper. Among them he found 4 genera and 65 species new to science, the preliminary descriptions of which have already been published. He has revised all previous work done on the subject, and shows that in the Magellanic region are found 243 endemic

* State Geol. and Nat. Hist. Survey Connecticut, Bull. No. 11 (1908) 203 pp.
† Rev. Bryolog., xxxvi. (1909) pp. 42–4.
‡ Pitard et Proust, Les Iles Canaries. Paris : Klincksieck, 1908, pp. 415–45.
§ Tom. cit., pp. 445–63.
‖ K. Norske Vidensk. Selsk. Skrift, 1908, No. 8, 35 pp.
¶ Rev. Bryolog., xxxvi. (1909) pp. 46–51.
** Bull. Acad. Internat. Geogr Bot., xviii. (1909) pp. 17–24.
†† Rev. Bryolog., xxxvi. (1909) p. 45.
‡‡ Schwedische Südpolar Exped., iv. pt. 8 (1908) 298 pp. (11 pls. and 61 figs.). See also Bryologist, xii. (1909) pp. 34–6.

species out of the total of 444 recorded; in South Georgia, 42 endemic out of 93; in Antarctica, 24 out of 47. He shows conclusively that the Magellanic moss-flora has closer affinity to that of Australasia than to that of Patagonia, the former land connection being probably indicated by the islands of Falkland, South Georgia, Kerguelen, Auckland, and New Zealand. On the Antarctic continent itself a slow immigration and adaptation of species has been going on.

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

Bisection of a Monad by a Diatom.*—P. A. Dangeard publishes a note on an instance of accidental bisection performed by a *Navicula* upon the minute unicellular organism *Chrysomonas flavicans* Stein. The *Navicula* acted like a knife, and by its own motive power pushed its way through the *Chrysomonas* and divided it into two portions, which after ten seconds came together and united again, the cell soon regaining its normal form and independent life. The author adds the following reflections:—1. The protoplasm of *Chrysomonas* is evidently very fluid, its particles having very feeble cohesion. The degree of cohesion might be actually measured by utilising this movement of the *Naviculæ* against droplets of substances having a known density and resistance. 2. We are still ignorant of the nature of the movements of diatoms. The theory that they move by excreting a gelatinous secretion from their posterior end is open to great doubt; for in the present case the secretion must at once have become of a higher consistence than that of the protoplasm of *Chrysomonas*. 3. The reunion of the two portions of the *Chrysomonas* shows the persistence of an attraction between the separated halves of a cell. What prevents two cells of the same species from uniting? There is an unknown law to be discovered here.

Periodicity in Spirogyra.†—W. F. Copeland has been studying the question of periodicity in *Spirogyra* during the past few years. He started some hundreds of aquaria, and found the best way to arrange a culture was to place sterilised earth in the bottom, add dead leaves or dead grass, and, after allowing all to settle down in the water, to add a small amount of *Spirogyra*, and place at first in a window not exposed to direct sunlight. The time of fruiting of any given species coincided with the time of fruiting in the wild state. Five p.c. of the cultivated material fruited. Of the thirteen species under cultivation twelve formed fruit; the other species, though kept under observation indoors and out since October 1905, has remained sterile. Ten of the species were at their maximum abundance in May, one in August, one in October. Secondary fruiting in July occurred in *S. dubia*. For the examination of wild specimens it was found to be expedient to carry the microscope into the field. Maximum abundance coincides in every case with maximum conjugation. After

* Bull. Soc. Bot. France, lv. (1908) pp. 641–3.
† Bot. Gaz., xlvii. (1909) pp. 9–25.

conjugation the fruiting and vegetative filaments all disappear. In the laboratory *Spirogyra* fruits not at the surface but always near the substratum; in the field the reverse holds good. Conjugation is found to result not so much from external as from internal conditions. *Spirogyra* evidently has definite periods of growth and activity.

Structure and Development of Martensia.*—N. Svedelius gives an account of the structure and development of *Martensia*. Finding the respective explanations by Harvey and Agardh as to the origin of the reticulate zone of the thallus to be insufficient and in conflict, he has investigated the matter for himself. He describes the true mode of formation of the reticulum, the development of the tetraspores, of the spermatia, and of the cystocarp. 1. He shows that the growth of the frond from an early stage is carried out almost exclusively by means of a characteristic intercalary cell-division which reaches its maximum in the formation of the reticulum; and that there are three types of this mode of growth represented by *M. fragilis*, *M. pavonia*, and *M. flabelliformis*. 2. The tetrasporangia are borne on the lamellæ of the reticulum normally, but in some species may occur simultaneously on the basa-disk. They are immersed; and their unicellular rudiments have, like the other cells of the plant, originally several nuclei each. These nuclei increase in number to perhaps fifty in the cell, and then degenerate and disappear—all but one, which, situated in the middle of the dense mass of tetrasporangial protoplasm, divides into the four definitive tetraspore-nuclei. 3. The spermatangia are borne only on the lamellæ in one or more sori on special male plants. They rise from superficial cells which by repeated division are cut up into uninucleate mother-cells, which then begin an apical growth and cut off one or two uninucleate spermatangia. Schmitz's view, that the spermatangia in the Florideæ are always apical cells of branches with apical growth, applies therefore to *Martensia* despite its otherwise strong intercalary mode of growth. The different modes of development shown by the spermatangium-mother-cells and their various methods of cutting off spermatangia afford important characters for distinguishing various types of organisation among the Florideæ, and have a systematic value. 4. The cystocarps are borne exclusively along the edges of the lamellæ. The carpogonium is an apical cell on a special branch with apical growth (as Schmitz has shown to be the case in the Florideæ always). All the cells in the carpogonial branch and carpogonium are multinucleate. After the fertilisation, the formation of the auxiliary cell and its division into foot-cell and central-cell, the gonimoblast-threads arise from the latter, and are all commonly uninucleate. They produce the carpospores, which are also uninucleate only.

Yellow-brown Cells of Convoluta paradoxa.†—F. Keeble has studied the life-history of the acœlous Turbellarian *Convoluta paradoxa*, which haunts shore algæ, and which is remarkable for containing certain yellow-brown algal cells. These cells are indispensable to the welfare of the animal: without them it dies. When starved it digests them and becomes infected again. The alga multiplies rapidly in the

* K. Svensk. Vet. Akad. Handl., xliii. No. 7 (1908) 101 pp. (4 pls. and 62 figs.).
† Quart. Journ. Micr. Sci., lii. (1908) pp. 431–79 (3 pls.).

animal, and feeds it with fat-globules, and utilises the nitrogenous waste products of the animal—probably uric acid. The alga is unknown in the free state.

Archerina transferred from the Protozoa to the Protophyta.*—E. Ray Lankester expresses the opinion that his *Archerina boltoni*, described in 1885 and referred to the Protozoa, is identical with *Golenkinia radiata* described by Chodat in 1894 and with *Richteriella botryoides* described by Lemmermann in 1898, and that the name *Archerina* should therefore take precedence over the other two generic names. Further, he treats of the organism *Botryococcus Braunii*, and publishes some drawings and notes prepared twenty-five years ago. He calls upon naturalists to study the plant for the elucidation of the following points:—(1) whether the green colour is chlorophyll or not; (2) what is the relation of the red and yellow oil pigment to the season; (3) how the oil passes into the jelly; (4) the nuclear structure; (5) modes of reproduction other than fission. The genus *Ineffigiata* of West is, according to its author, probably a form of *Botryococcus Braunii*.

New Endophytic Alga in Nostoc.†—F. Hustedt describes a new endophytic species of *Dactylococcopsis*, *D. mucicola*, a small blue-green alga which grew abundantly inside the jelly of a cultivated *Nostoc*. He contrasts it with *D. rupestris* Hansg., a free-growing species, and with *D. montana* West, which forms colonies in jelly of its own production.

Fish infested with Algæ.‡—K. Minakata cites a record by A. D. Hardy § of the occurrence of the green alga, *Myxonema tenue* Rabenh., growing luxuriantly upon goldfish in a pond, and himself describes a similar occurrence in the case of some diminutive fish (*Haplochilus latipes* Schleg.) captured in a tiny pool in the Asso Marsh near Tanabe, Kii, Japan. The tufts of alga were 1 cm. long, and were attached to the underside of the fish. The alga is determined by G. Massee as being the same species, *Myxonema tenue*, and associated with it is a species of the desmid *Euastrum*.

Red Snow.‖—G. S. West gives a short account of *Sphærella nivalis*, the alga which causes the coloration of extensive tracts of snow in the Austrian, Swiss, and Italian Alps, in Norway, South America, and the two polar regions. The red colour is caused by a red pigment known as hæmatochrom, which generally accompanies diminished vitality, and being more stable than chlorophyll, enables the cells to exist much more easily through adverse circumstances than if they were merely green. The life-history of *S. nivalis* is briefly described, and remarks are made on the specific differences between it and *S. lacustris*. The author is not inclined to accept *S. nivalis* as a species of *Chlamydomonas*, without further knowledge of its motile state.

* Quart. Journ. Micr. Sci., lii. (1909) pp. 423–30 (pl.).
† Hedwigia, xlviii. (1908) pp. 140–1 (figs.).
‡ Nature, lxxix., No. 2039 (1909) p. 99.
§ Op. cit., April 1907.
‖ See this Journal, 1909, pt. 1, pp. 28–30.

Phycological Studies.*—M. A. Howe continues his studies of West Indian algæ, and in the present paper, No. IV., he treats first of the genus *Neomeris*. He describes the genus and six species, of which three are new, *N. van Bosseæ*, *N. stipitata*, and *N. mucosa*. Important critical notes are appended to each diagnosis. The next section of the paper is devoted to two West Indian species of *Acetabulum*, of the Polyphysa section; *A. pusillum*, a new species; and *A. polyphysoides* Kuntze, with a new form, *deltoideum*. Then comes a description of a new *Halimeda*, *H. lacrimosa*, belonging to the *H. Tuna* group. A section follows on *Udotea conglutinata* and *U. cyathiformis*, which the author holds to be distinct species. He gives diagnoses of both, and a key of the more important diagnostic characters. Finally, he describes a new species of *Udotea*, *U. spinulosa*, and appends a note on *U. palmetta*.

Movement of Diatoms.†—Otto Müller continues his studies on this subject, and in the present contribution deals with the structure of the raphe, criticising the views of Otto Heinzerling, and giving the result of his investigations on the topographical conditions of the raphe of *Pinnularia*, founded on over 700 measurements of the larger species.

Diatoms of Bremen.‡—F. Hustedt publishes, as a contribution to the algal flora of Bremen, an account of a rich haul of Bacillariaceæ or diatoms obtained from a pool in the environs of Bremen. Fifty-nine species were obtained, and the list may still be incomplete.

Fresh-water Plankton of Italy and Germany.§—E. Lemmermann publishes three further contributions to a knowledge of the plankton algæ. 1. In article 23, he treats of the phytoplankton of the Lago di Varano and of the Lago di Monate, which lie to the north-west of Milan. The material was gathered by G. Besana ten years ago. The periodicity of the chief forms is worked out and shown in tables; and the relation of this to the conditions of temperature is considered. The shallower Lago di Varano ($7\frac{1}{2}$ metres) resembles in the composition of its plankton the shallower lakes of North Germany. And the deeper Lago di Monate (27 metres) has an alpine character. 2. In article 24, the author gives an account of the material gathered at eleven stations in Silesia by D. Schmula. 3. In article 25, he treats of the algæ of the Stralsund water-supply, which is brought from the Borgwall Lake, distant 6 to 7 kilometres. He describes the species found in the lake-water, in the sand of the filter-bed, and in the gravel of the same.

Phytoplankton of Victoria Nyanza.‖—C. H. Ostenfeld writes on some phytoplankton from the Victoria Nyanza gathered by A. Borgert in 1904–5. He finds the species of *Microcystis* to be ill-defined. *M. æruginosa*, and *M. viridis* Lemm. and *M. flos-aquæ* Kirchn. cannot be separated. The data of West and Schmidle on *Microcytis*-forms in plankton from Victoria Nyanza and Lake Nyassa are to be referred to one species. The two species of *Cothurnia*, described by E. von Daday

* Bull. Torr. Bot. Club, xxxvi. (1909) pp. 75–104 (8 pls.).
† Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 27–43 (1 pl. and text figs.).
‡ Abh. Nat. Ver. Bremen, xix. (1908) pp. 353–8.
§ Arch. f. Hydrobiol. u. Planktonkunde, iii. (1908) pp. 349–410 (figs.).
‖ Engler's Bot. Jahrb., xli. (1908) pp. 330–50 (figs.).

as epiphytic on colonies of *Gomphosphæria aponina*, belong to *M. æruginosa*. The genus *Sphinctosiphon* of G. S. West also belongs to *Microcystis*. *Anabæna flos-aquæ* f. *discoidea* Schmidle is declared to be a good species. *Botryococcus Braunii* Kütz. is a variable species. The author shows in a tabular form the relative frequency of the species at each of the four stations visited by Borgert; and contrasts Borgert's results with those of Stuhlmann and Cunnington and with what is known from Lake Nyassa. In a general summary the author states that the great African lakes are distinguished by their proportional richness in rare tropical species. The principal species in the two lakes are the same; of the 95 species 37 are common to both. But Nyassa has 24 species, and Victoria Nyanza has 34, which are respectively not found in the other lake. The plankton of Tanganyika is very different.

Phytoplankton of the Aral Sea.*—C. H. Ostenfeld gives an account of the phytoplankton of the Aral Sea and its affluents with an examination of the algæ observed. Except for an almost unknown short paper by E. G. Borszcow in 1877, this district has remained untouched. The materials for the present report, 82 samples, were collected by L. S. Berg's expedition in 1900–3. The list contains 19 Myxophyceæ, 6 Chlorophyceæ, 6 Flagellatæ, 1 Silicoflagellata, 13 Peridiniales, 58 Bacillariales. The author describes nine new species and makes critical remarks on older ones. He treats of the fresh-water phytoplankton of the affluents Syr-Daria and Amu-Daria, and tabulates the results obtained from them and from the Aral Sea itself. The paper forms the eighth part of the scientific report on the Aral Sea Expedition.

Phytoplankton of the English Lakes.†—W. and G. S. West report on the phytoplankton of the English lakes. In an introduction the authors refer to the important relationship which exists between the geological character of a district and the constituents of its alga-flora, more especially of its desmid-flora. They point out that the entire Lake District is an Older Palæozoic area, and that the really rich alga-floras are all on Older Palæozoic. The English Lake District possesses a richer alga-flora than any other part of England, although not quite equal to that of the north-west of Scotland or the west of Ireland. The phytoplankton of the lakes is similarly rich in species, although not so prolific as the limetic flora of the lakes of the north-west of Scotland. In all, eighteen lakes were examined for their phytoplankton, and detailed accounts of them are given. Moreover, a general distribution table is appended displaying 135 species and varieties of Chlorophyceæ and 32 of Bacillarieæ.

Algæ of the Yan Yean Reservoir.‡—G. S. West has issued an exhaustive report on the algæ of the Yan Yean Reservoir, Victoria, which is of special importance, inasmuch as it constitutes the first

* Isw. d. Turkest. Abteil. d. k. Russ. Geogr. Ges., iv. (1908) pp. 123–225. See also Hedwigia, xlviii. (1908) Beibl., p. 102.

† Naturalist, No. 626 (1909) pp. 115–22 (3 pls.); and No. 627, pp. 134–41.

‡ Journ. Linn. Soc. Bot., xxxix. (1909) pp. 1–88 (pls. and figs.).

plankton investigation of Australian fresh-waters. The fact, too, that the collections examined were made at short intervals over an extended period of time, adds to the value of the report. In an introduction, the author describes the reservoir and the drainage area, and gives information concerning the spermatophytic and pteridophytic flora of the district. This is followed by several chapters, of which the first three deal respectively with the phytoplankton of the Yan Yean Reservoir, the littoral alga-flora, and the general alga-flora of the drainage area. The algæ of the entire area, and the different parts of it, are then discussed in their various relationships; the more important and interesting species are dealt with systematically; and lastly, attention is drawn to the peculiarities of the alga-flora of Australasian fresh-waters. In a general summary, the author states that the phytoplankton of the Yan Yean Reservoir is rich both in number of species and individuals. It reaches its greatest development in March and April, and is poorest in September and October. The Flagellates are not numerous and the Mycophyceæ are remarkably few. *Ceratium Hirundinella* is absent. It has a rich desmid-flora containing many characteristic Australasian types. In respect of this great development of desmids it compares very well with the lakes of western British lake-areas, and furnishes another instance of a rich desmid-plankton occurring in a lake situated on the Older Palæozoic formations and receiving the drainage from extensive outcrops of these old rocks. The microphytic benthos or littoral alga-flora of the Yan Yean Reservoir was richer in species than the phytoplankton, and it was found that many species common to the plankton and the benthos attain first a maximum in the plankton and subsequently a maximum in the benthos. The phytoplankton is partially recruited from the microphytic benthos, and it also consists in part of well-established forms which are not recruited from the shore-regions. The origin of some of the plankton species, even dominant forms, is at present a mystery. Over 300 species of algæ were observed from the entire Yan Yean drainage area. Of these, 14 species and 11 varieties are here described for the first time, and 4 species and 5 varieties, previously only partially described, are here dealt with in greater detail, and for the first time figured.

Fresh-water Algæ of Connecticut.*—H. W. Conn and L. W. Webster publish a preliminary report on the algæ of the fresh-waters of Connecticut, consisting of descriptions and analytical keys, with numerous figures.

Carpogonium and Auxiliary Cell of Melobesieæ.†—F. Heydrich describes the process of fertilisation of some of the Melobesieæ. He finds that the sporogenous nucleus seeks out another cell, which then becomes a spore, and this may take place in one of three ways. 1. The sporogenous nucleus comes out of the carpogonium and enters into a row of cells specially adapted before fertilisation for the purpose, traverses this, and finally coalesces at the further margin with another nucleus and becomes a spore. 2. The sporogenous nucleus goes straight

* State Geol. and Nat. Hist. Survey, Bull. 10 (1908) 78 pp. (44 pls.).
† Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 79–84 (1 pl.).

to another cell lying below it which detaches itself and becomes a spore. This detached cell is always the last peripheral one of a row of cells specially adapted among the procarpia before the fertilisation. 3. A free sporogenous cell coalesces with a peripheral sterile thallus-cell, undeveloped before fertilisation, which then becomes a spore. The different views of Thuret and Bornet, Graf Solms, and Schmitz are given.

Indian Ocean Algæ.*—R. Pilger has studied specimens of *Trichoglœa Requienii* gathered by Voeltzkow on reefs at Sainte-Marie in Madagascar, and gives an account of the growing-point, the ramification, the calcification, the development of the carpogonia from the fertilisation of the trichogyne to the formation of the spores; and also the antheridia.

He also describes † the Corallinaceæ gathered by Voeltzkow in the western part of the Indian Ocean, on the coast of Madagascar and the neighbouring islands. There are twelve species, two of which are new. The structure of eight of them is figured.

Algæ of Peru, Chile, and South-west Africa.‡—R. Pilger gives an account of two small collections of marine algæ. The first, brought by Captain Paessler from Peru and Chile, contains twenty-one species, two of which are new, viz. *Actinococcus exul* (epiphytic on *Rhodymenia*), and *Nitophyllum Pæssleri*. The second collection came from German South-West Africa, and contains fourteen species, almost all of South African type. Among them is one new species, *Chætangium magnificum*.

Mazza, A.—**Saggio di Algologia oceanica.** (Studies in Marine Algology.)
[A continuation, in which species of *Laurencia*, *Acanthophora*, and *Chondria* are described.] *Nuov. Notar*, xx. (1909) pp. 6–18.

Fungi.

(By A. Lorrain Smith, F.L.S.)

Zygorhynchus Moelleri Vuill. §—P. Wisniewski obtained this member of the Mucorini by culture from garden soil, and made a series of physiological experiments and observations. He obtained both sporangia and zygospores, the latter, he considers, probably from the union of two dissimilar gametes. On a poor substratum, such as distilled water or pure agar, he obtained only sporangia, that is, in conditions that hampered the growth of the colony. With other conditions more favourable to development of aerial hyphæ he obtained zygospores.

Study of Synchytrium-galls.‖—Hermann Ritter von Guttenberg has made a detailed study of the cells forming the excrescences caused by parasitic *Synchytriæ*. The material examined belonged to the section

* Voeltzkow, Reise in Ostafrika. III. Stuttgart: Schweizerbartsche Verlagsbuchhandlung, 1908, pp. 35–7 (pl.).
† Tom. cit., pp. 39–48.
‡ Hedwigia, xlviiii. (1908) pp. 178–83 (pl.).
§ Anz. Akad. Wiss. Krakau Math. Nat. Kl., 1908, No. 7, pp. 656–82 (figs.). See also Bot. Zeit., lxvii. (1909) pp. 55–6.
‖ Jahrb. Wiss. Bot. xlvi. (1909) pp. 453–77 (2 pls.).

Pycnochytrium, in which the zoosporangiate sori escape from the host-plant. The cells in which they are formed grow to very large dimensions, and in some species the neighbouring cells also share in the transformation. The galls examined were found on *Mercurialis perennis*, *Anemone nemorosa* and *Adoxa Moschatellina*. In each case the author describes the normal host cells, and contrasts them with the deformed cells that serve as hosts to the parasite. The latter increase to a very large size ; the neighbouring cells may divide repeatedly, but they do not become so large. The host-cell is filled with a somewhat thick plasma, the chloroplasts are abundant, but contain little or no starch ; the nucleus lies close to the *Synchytrium* spore and attains a very large size ; the nucleoli also show considerable increase in volume. The substance of the nucleus is traversed by a branching system of canals, which unite in a large opening towards the side of the nucleus next the parasite. Details are given of the division of these nuclei.

The resting spores of *Synchytrium* have a thick wrinkled chitinous membrane, the interior plasma contains numerous vacuoles : a large nucleus lies in the centre with a distinct nuclear wall and two or three small nucleoli.

Monascus purpureus.*—Andre Piedallu noted that during the operation of tanning leather with oil various changes took place in the substances used. Several bacteria and moulds have been isolated that play important parts in the processes, and notably *Monascus*. This fungus has been studied by various authors on account of its rather remarkable morphology. Piedallu examined it for its physiological properties and grew it on a large number of substrata, noting the colour effects, etc. He finds that *Monascus* acidifies the oils employed, thickens them and colours them brown, and secretes an oxydase. He concludes that it plays an important part in the tanning process.

Observations on the Morphology of the Oidium of the Oak.†
The recent appearance and rapid spread of this parasite have roused the interest of plant pathologists. Teodoro Ferraris has made a thorough study of the fungus and compared it with others recorded on the same host. It attacks chiefly young trees, covering the leaves with a white felt. The author describes the different phases of growth, mycelium, conidiophores, conidia, etc., and then takes up the question of identity. By most authors it has been referred to *Microsphæra Alni*, but Ferraris disputes this, and considers rather that it is *Oidium quercinum* Thum. var. *gemmiparum*. The ascophorous form has not yet been detected, but he thinks that it is probably either *Microsphæra densissima* or *M. quercina*, both of which are parasites of the oak.

Specialisation of Sphærotheca Humuli within the genus Alchemilla.‡—J. A. Steiner has conducted a large series of infection experiments on plants of this genus, which he divides into various groups ; he took ascospores and oidia from representatives of these groups, and made inoculations on the whole series of plants. The

* Comptes Rendus, cxlviii. (1909) pp. 510–13.
† Ann. Mycol., viii. (1909) pp. 62–73 (1 pl.).
‡ Centralbl. Bakt., xxi. (1908) pp. 677–736 (1 pl. and 3 figs.).

results are printed in tabular form, and provide some interesting reading. He found no difference in the results when ascospores were used for inoculation, and all attempts to infect plants other than *Alchemillæ* were unsuccessful. He concludes that within the biological species *Sphærotheca Humuli* f. sp. *Alchemillæ* there have arisen minor biological species distinguished by the ease or difficulty of infection in the different *Alchemilla* groups.

Biology of Botrytis cinerea.*—In spite of all the investigations that have been made on this fungus, many points in its development are imperfectly known. F. L. Brooks has, therefore, examined it with a view to obtaining more exact knowledge. In grape-sugar extract with gelatin the *Botrytis* developed normally and vigorously. In Kleb's solution, growth was scanty; on bouillon-gelatin, only microconidia were produced on the conidiophores for the first three generations. In the fourth generation growth was again normal, the fungus evidently having become accustomed to the medium; no sclerotia, or organs of attachment, were, however, formed in the bouillon cultures. In the infection experiments, lettuce plants were used: the conidia sown on healthy plants produced no effect, but on yellowing leaves, or when the plant was wounded, infection took place. Experiments were also carried out on lettuce plants that had been deprived of certain mineral constituents; but the results were negative, agreeing with Marshall Ward's experiments on the parasitism of *Puccinia dispersa*. Brooks also found that starving the host-plant had no appreciable effect on its liability to infection.

Nutrition of Botrytis cinerea.†—By a series of cultures, Henri Colin has tested the relative value to fungi of the different substances in the Raulin liquid with and without glucose. He obtained the *Botrytis* by exposing ripe grapes to the air. The fungus would not develop on glucose alone, only some tufts of white mycelium being formed. Various salts were added to the medium, and the results in each case are recorded. As a general result he finds that, though *Botrytis* does not grow in the total absence of one or other of the substances necessary to its full development, it can utilise them when present in extremely minute quantities. The proportion of each most favourable to its growth has not yet been determined.

Yeast Fungi.‡—F. G. Kohl has published a book which includes the consideration of the organisation, physiology, biology, and systematic account of yeasts and allied fungi. He gives his views on the nucleus of the yeast-cell. In the resting stage it is much like that of other plant-cells, possessing a distinct membrane, nuclear sap, and a crystalloid. Kohl is sceptical in regard to karyokinetic division; he leans rather to direct division so far as his own observations have gone. Dumb-bell division is constantly to be seen in the budding cells, but the young cell may be quite a large size before it receives its nucleus.

* Ann. Bot.., xxii. (1908) pp. 472–87 (4 figs.).
† Rev. Gén. Bot., xxi. (1909) pp. 97–116 (3 pls.).
‡ Die Hefepilze, Leipzig, 1908. See also Bot. Centralbl., cviii. (1908) pp. 611–14.

In the contents of the yeast-cell, Kohl distinguishes between albumen crystals and metachromatic bodies: they differ in their relation to stains, and in their solubility in various reagents. Succeeding chapters are devoted to enzymes, fermentation, and the life of the cell; classification and allied organisms which cause fermentation are also dealt with.

Development of Glœosporium nervisequum.*—A great deal of interest has been concentrated on this fungus since Viala and Pacottet announced that they had produced a yeast form in which endogenous spores like those of *Saccharomyces* were formed. A. Guilliermond has taken up the question: he recounts the results obtained by the previous workers, and describes in detail his own cultures and observations. The fungus he finds, grows very differently according to the culture medium employed, liquid or solid, growing more quickly and more abundantly on solid substances of a sugary nature. There was no formation of yeast observed to have developed from *Glœosporium* in either series of cultures, though two distinct yeasts were found in the cultures as impurities. Guilliermond sums up by stating that at no stage of the life-cycle of *G. nervisequum* is there a yeast produced, and, therefore, no fresh light has been thrown on the origin of the yeast plant.

Notes on Glœosporium.†—J. Lind finds that *Exobasidium Brevieri* Boud. is identical with *Glœosporium filicinum* Rostr. The fungus belongs to the group of Protobasidiomycetes, and is the type of a new genus *Herpobasidium.* The species grows on various ferns. Other species on ferns determined as *Glœosporium* belong to the Uredineæ. On the catkins of willows he has found four different forms of *Glœosporium.*

Uredineæ.—Ivar J. Lire‡ has published a text-book of the Uredineæ of Finland, and describes in full 246 species, giving also biological and morphological notes on the group. The diagrams are exact and trustworthy, and critical remarks are included from time to time. Several species are new to science.

The same writer§ has issued a paper on his culture experiments with these fungi: there is no æcidium form of *Melampsora betulina* in the country, and he is of opinion that the mycelium winters in the tissue of the leaves and buds of seedlings, but not in the buds of older plants. The rust always begins in spring on the fresh-developed leaves of birch seedlings, and produces generation after generation of uredospores. Experiments were also conducted on *Chrysomyxa Ledi*, *Cronartium*, *Peridermium-Pini*, etc., etc.

J. L. Sheldon‖ has verified the surmise that the *Uromyces* on *Sisyrinchium graminoides* is a stage of *Æcidium houstoniatum*; by inoculation with the spores of the latter he obtained the *Uromyces*, and finally reproduced the æcidium on *Houstonia cærulea* from teleutospores

* Rev. Gén. Bot., xx. (1908) pp. 385–400; 429–40; 449–60 (9 pls. and figs.).

† Ark. Bot., vii. No. 8 (1908) 25 pp. (3 pls.). See also Centralbl. Bakt., xxii. (1908) p. 466.

‡ Helsingfors, 1908, 642 pp. (Swedish).

§ Act. Soc. Faun. and Fl. fenn., xxix. (1907) 58 pp. (6 figs.). See also Ann. Mycol., vi. (1908) pp. 580–1.

‖ Torreya, xi. (1909) pp. 54–6.

of the *Uromyces* form. Cultures on *H. purpurea* gave negative results. Sheldon is of opinion that *Houstonia* is infected during the summer and autumn, and that the mycelium remains dormant until spring. The teleutospores germinate in the living plant, and it is rare in such cases that there is any æcidial stage. Successful culture experiments were also made with *Uromyces Andropogonis*, and æcidia were produced on violet leaves.

Origin of Specialisation and Heterœcism in Uredineæ.* — W. Krieg considers that a sudden change of host among rusts may be explained by close chemical affinity between the old and new; when the transference is to a host of a different family of plants, he thinks that there is a case of mutation of the fungus. The origin of heterœcism may be explained also by mutation: at a certain stage in the history of the rust, the uredo- and teleutospore stages established themselves on some different plant. Brachy-, lepto- and mikro-forms arose, chiefly on vegetation of early spring or in high altitudes, through the dropping out of some spore forms.

German Flora.† — W. Migula is issuing the above Flora in parts, and the last published deals with Fungi. These are divided into the four great groups of slime-fungi (Myxomycetes), algal-fungi (Phycomycetes), ascus-fungi (Ascomycetes), and basidio-fungi (Basidiomycetes). It is with the first of these groups that the present issue deals, and included under the Myxomycetes are the Acrasieæ and the Photomyxineæ, as well as Myxogastres or Mycetozoa. These organisms are all saprophytes except the Photomyxineæ including *Plasmodiophora*, *Tetramyxa*, and *Sorosphæra*, all of them parasites on living plants. The Myxogastres, by far the largest and most important group, are divided into eleven families. In the second and third fascicles the Myxomycetes are concluded and the Phycomycetes are commenced. These are divided into two orders, Oomycetes and Zygomycetes.

Contribution to the Mycology of South Africa.‡ — W. Cheesman spent some time in the autumn of 1905 in South Africa, and the present list includes the fungi collected by him at Victoria Falls and elsewhere. He notes the cosmopolitan character of many of the species, and also the close affinity between the fungi of South Africa and Australasia, an indication of the supposed ancient land-connection between the two countries. One species, *Cyphella Cheesmani* Massee, is new to science. A note is added by T. Gibbs on the coprophilous fungi of the same region. These grew on pellets of dung brought home by Cheesman, and handed to Gibbs for cultivation and observation. There is one new species, *Coprinus Cheesmani* Gibbs. Most of the forms are Pyrenomycetes of the Sordariæ family.

Study of the Album Pelletier de Guerniac.—Fernand Guéguen bears witness to the extreme value of the unpublished drawings of

* Naturw. Wochenschr., neue folge, vii. pp. 561–73. See also Bot. Centralbl. cviii. (1908) pp. 614–15.

† Flora von Deutschland, Krypt. Flora, lief 66–9 (1909) pp. 1–80 (23 pls., 4 col.).

‡ Journ. Linn. Soc. Bot., xxxviii. (1909) pp. 408–17 (pl.).

§ Bull. Soc. Mycol. France, xxiv. (1908) pp. 247–69 (2 figs.).

fungi by Pelletier now in the possession of Viscount Guerniac of Morlaix. There are six volumes, each one with a frontispiece of quaint figures composed of fungi, of which two examples are given in the text. A general revision of the drawings was made by Léveillé, who added many notes on the figures. The plates are carefully dated. In vol. v. there are also twenty-two lichens and one hepatic figured. The author gives a considerable number of species, with the notes of Pelletier and Léveillé.

Poisonous Fungi.*—L. Magnin contributes a note on the toxic character of *Amanita junquillea*. He cites cases of illness caused by eating the fungus, but also states that certain people have eaten the fungus for years with impunity. He draws attention to the fact that plants vary in different seasons and in different localities, also that the poisonous qualities may be confined to definite parts of the plant.

L. Masse† reports on a case of poisoning at Vendome due to eating *Amanita phalloides*. In one case it ended fatally. Masse recommends publishing plates, carefully printed and coloured, of some half-dozen of the most venomous species.

Treatment of Monotypic Genera of Fungi.‡—In view of the International Congress to be held at Brussels, C. L. Shear puts forth a plea for the type system in the understanding and description of fungi. He cites a number of cases where this system has not been observed, the species first described, and hence the type species, having been transferred to other genera of more recent origin. The confusion has arisen in the case of micro-fungi largely from the failure of early authors to appreciate microscopic details essential to a proper diagnosis.

Yorkshire Fungi.—C. Crossland § records the fungi collected by the Yorkshire Naturalist Society on various excursions. *Sclerotinia sclerotiorum* was found in abundance near Myton Grange. Over 100 species were collected in north-west Yorkshire. Another list ‖ of fungi from north-east Yorkshire is contributed by T. Gibbs, in which is included *Nolanea minuta* Karst., a species new to Britain.

C. Crossland ¶ also records the finding of *Hypocrea riccioides* in Great Langdale, Westmorland. The first record was made by Bolton, who found it in New Halifax "on decaying branches of sallow and hazel in February 1790." Crossland adds a new description and figures of the plant. The same writer ** gives a list of fungi from Hornsea Mere, in south-east Yorkshire, including *Tapesia retincola*, a species new to Britain. It grows on dead stems of *Phragmites*. He also describes †† *Naucoria nucea*, a rare species collected at Clapham, in Yorkshire, first discovered by Bolton near Halifax, in 1787.

The same writer ‡‡ publishes an account of the annual fungus foray, which took place in September in the Mulgrave Woods. The

* Bull. Soc. Mycol. France, xxiv. (1908) pp. 270–2.
† Tom. cit., pp. 273–5.
‡ Bull. Torrey Bot. Club, xxxvi. (1909) pp. 347–51.
§ Naturalist, 1908, pp. 282–4.
‖ Tom. cit., pp. 409–11.
¶ Tom cit., pp. 371–2.
** Tom. cit., pp. 309–10.
†† Tom. cit., pp. 385–6.
‡‡ Op. cit., 1909, pp. 21–7.

season was favourable, and the locality so rich in species, that 612 species and twelve varieties were collected in a few days. Three species new to Britain were found—*Tricholoma carneolum*, *Pholiota sororia*, and *Inocybe commixta*. One of the most interesting species met with was *Bolbitius Boltoni* Fr. A list is added of the fungi collected.

British Mycology.*—A series of papers are published in the Annual Transactions of the Mycological Society dealing with various aspects of our fungus flora. An account is given of the annual fungus foray held last autumn at Drumnadrochit in Inverness-shire, and the species observed are enumerated. The list is especially rich in micro-fungi collected chiefly by D. A. Boyd. Carleton Rea, the President for the year, gave in his address a résumé of Patouillard's scheme of classification of the Hymenomycetes, with notes on many of the larger fungi from personal observation. Em. Boudier contributes the diagnosis of a new and interesting Discomycete, *Pseudo-phacidium Smithianum*. It occurs as a parasite on *Empetrum nigrum*. A. Lorrain Smith supplies a second record in this country of *Myxococcus pyriformis*, the only member of the Myxobacteriaceæ that has been detected here. R. H. Biffen records two species of Laboulbeniaceæ, *Stigmatomyces purpureus* on specimens of *Scatella* from North Cornwall, and *Laboulbenia vulgaris* on various hosts, chiefly *Bembidium* collected at Durnford Fen, Cambridge. These are the first records of the order for Great Britain. M. C. Cooke discusses the identity of *Hygrophoris Clarkii*: there are three different diagnoses of species, each purporting to be *H. Clarkii*. Cooke thinks the species had better be ignored, as no one knows which is the true one. C. Crossland publishes a long and useful list of omitted ascus and microscopic measurements of Ascomycetes. A new *Clavaria* is published by W. B. Allen. A. D. Cotton gives notes on marine Pyrenomycetes, new species or new to Britain. An instructive paper, "Recent Work on the Reproduction of Ascomycetes," has been written by H. C. Fraser. It sums up the work done in that branch of mycology, giving succinctly and clearly the new discoveries that have been made by herself and other research workers, and indicating the bearing that these new facts have on the relationships of the different groups. Much work still remains to be done on the subject. T. Petch sends from Ceylon an account of the Bleeding-stem disease of the Cocoanut-tree, caused by a black mould, a species of *Thielaviopsis*. A series of notes on fungi are contributed by M. C. Cook, and finally the usual lists of new and rare fungi are provided by A. Lorrain Smith and Carleton Rea, with an additional list by H. C. Hawley. The large number of new species for the year testifies to the good work done by members of the society.

Gooseberry Mildew.†—J. Eriksson gives an exhaustive paper on this subject. He describes the appearance of the fungus and its occurrence in America and Europe. In addition to gooseberry bushes it attacks *Ribes nigrum*, *R. rubrum*, and *R. aureum*. No varieties or

* Trans. Brit. Myc. Soc., Season 1908 (1909) 130 pp. (6 pls., 3 col.).

† Prakt. Bl. Pflanzenb. Pflanzensch., vi. (1908) pp. 121–6. See also Bot. Centralbl., cx. (1909) pp. 147–8.

forms of the gooseberry have as yet been found that are immune to the fungus. The only possible method of dealing with it is to burn the whole bush that has been attacked. Eriksson considers that the fungus is not only superficial on the leaves and twigs, but that it invades the host and persists inside the tissues. He compares this with his mycoplasma-hypothesis as interpreted by him in the Uredineæ.

Gooseberry Mildew.*—R. Schander writes a paper on the present condition of this new gooseberry disease in Germany, and he has supplied maps of East and West Prussia covered with black dots to indicate the localities in which it has appeared. He considers that the pruning and removing of all twigs and leaves on which the perithecia of the fungus (*Sphærotheca Mors-Uvæ*) were found is the best method yet tried to combat the pest. The fungus is disseminated by infected fruits and by the action of wind, insects, and human beings in carrying the conidia or summer spores. The writer himself found that he had carried spores from the laboratory to his own garden. Opinions vary as to the condition of the berries that are attacked: in some cases they are reputed as bitter and unfit for eating or cooking; in others they were found to be lacking in taste and wanting both in sugar and acidity. As a final advice he recommends rooting up and destroying all the bushes attacked, though he acknowledges that it would be difficult to carry out such a drastic remedy.

Plant Diseases.—A. Spieckerman,† G. Schneider,‡ and Jösting § have each published an account of black scab in potatoes caused by the fungus known as *Chrysophlyctis endobiotica*. The disease was notified first in Hungary and then in England, where it has by some authorities been wrongly referred to *Œdomyces leproides*. Spieckerman reports the disease from Westphalia, where it has been observed for three years. Schneider and Jösting announce its appearance in Dusseldorf and Elberfeld. Potato growers have been familiar with it in the latter neighbourhoods for some years, but lately it has increased considerably. Magnum Bonum potatoes were specially attacked. Change of crops is recommended on infected ground. The development of the fungus is not fully known.

Chrysanthemum rust ‖ has been reported from Limpsfield (Surrey), and apple leaves attacked by the minute fungus *Phyllosticta Mali* were found at Crewkerne. Spraying with Bordeaux mixture cures the leaves. *Septoria Lycopersici* on tomato plants, *Thoma Grossulariæ* on gooseberry, and *Rhizoctonia violacea* on potatoes were also noted in various localities. In a note on spraying, agriculturalists are warned against spraying when the buds are opening, as the different copper and caustic soda solutions injure the young leaves.

An exhaustive research by F. C. Stewart and H. E. Hodgkiss ¶ proves that the *Sporotrichum* bud-rot of carnations and the "silver

* Zeitschr. Pflanzenkr., xviii. (1908), Beigabe phytopath. Dienst. 4, pp. 97–121.
† Prakt. Blätt. Pflanzenb. Pflanzensch., vi. (1908) pp. 113–16 (2 figs.).
‡ Deutsch. Landw. Pr., xxxv. (1908) p. 832 (2 figs.).
§ Tom. cit., p. 883. See also Bot. Centralbl., cviii. (1908) pp. 632–3.
‖ Journ. Board. Agric., xv. (1909) pp. 752–3.
¶ New York Agric. Exp. Stat. Tech. Bull. 7 (1908) 119 pp. (7 pls.).

top" of June grass, *Poa pratensis*, are due to the same fungus, which in both cases is associated with a mite. Inoculations were made on healthy carnation buds, and thirty-six of these were successful, the buds becoming diseased and covered with the fungus. A description of the mite is also given. It was not present on the experimental buds, and was occasionally absent from diseased grass heads, but as a rule it is present and probably helps largely in disseminating spores. There was not sufficient evidence to prove that the mite fed on the fungus spores.

Ewert * reports the first appearance in Germany of *Septoria Azaleæ*, a fungus that attacks the leaves and buds of Azaleas and causes them to die off prematurely. The disease is reported from Silesia.

R. Laubert † has examined the mildew of apple trees as to the proper determination of which there was some doubt. He fortunately found a good development of perithecia, and was able to assign it to its proper position as *Podosphæra leucotricha*. He recommends the careful pruning and destroying of all twigs attacked, and powdering the trees with sulphur or spraying with sulphur solutions.

P. Magnus ‡ describes some parasitic fungi from the Argentine. *Albugo candida*, very common in Europe, has probably been taken across the ocean with cruciferous plants. The author discusses other species of the genus that also occur in South America. *Roestelia intervenienss*, found on *Malvastrum tenellum*, is also described, and another æcidium form, *A. Kurtzii Friderici* sp. n., on the under side of leaves of *Gentiana* sp.; the other spore forms have not been detected.

Th. Wulff § describes some diseases of *Ribes* due to *Botrytis*. On *R. aureum* a species of the fungus settled in wounds of the branches and thence passed to healthy shoots. Another attack by *Botrytis* is recorded on the leaves of *R. rubrum* and *R. grossularia*. The spores had germinated in the drops from water-stomata and had penetrated and killed the leaves.

H. Morstatt ‖ describes the ravages of *Glœosporium fagicolum* on beech-trees in the Island of Rügen. The diseased leaves fall early and the trees are left bare. The higher fruit form has not yet been discovered.

F. L. Stevens and J. G. Hall ¶ describe a hypochnose of Pomaceous fruits—a leaf-blight of apple, pear, and quince—in the United States. The disease shows roundish sclerotia on the twigs and rhizomorphic structures like ribbons which pass along the twigs and form on the under side of the leaves a felt of mycelium. The authors refer the fungus to *Hypochnus ochroleucus*. It is superficial on leaves and twigs, and might be removed by spraying in spring when growth begins.

Hiltner ** publishes notes on the rolling of potato leaves due to the fungus *Fusarium*. He denies that the colouring of the bundle system

* Zeitschr. Pflanzenkr., xviii. (1908), Beigabe 4, p. 121.

† Deutsch. Landw. Presse, xxxv. (1908) pp. 628–9 (3 figs.). See also Bot. Centralbl., cx. (1909) p. 41.

‡ Hedwigia, xlviii. (1908) pp. 147–51 (5 figs.).

§ Ark. Bot., viii. No. 2 (1908). See also Bot. Centralbl., cx. (1909) p. 148.

‖ Ann. Mycol., viii. (1909) pp. 45–8 (2 figs.).

¶ Tom. cit., pp. 49–59 (8 figs.).

** Prakt. Bl. Pflanzenb. Pflanzensch., vi. (1908) pp. 25–30. See also Ann. Mycol., vii. (1909) p. 83.

is sufficient proof of the presence of the fungus, as the brown coloration may be present in healthy plants.

C. E. Klugkist * gives an account of parasitic fungi in north-west Germany. Species of *Plasmopara*, *Peronospora*, several fungi imperfecti, the Basidiomycetous *Exobasidium* on Rhododendrons, and various Uredineæ are recorded by him. He adds an alphabetical list of the hosts with the parasitic fungi that have attacked them.

Mycorhiza.†—G. A. Duthie and D. M. Matthews made a superficial and later a microscopic examination of twenty-six species of roots of forest-trees to determine the presence and nature of any mycorhizal fungi. Sixteen of those trees were found to have ectotrophic mycorhiza on their rootlets, seven had the endotrophic form, and three trees, ashes and willow, were apparently unaffected. The ectotrophic species were the red, white and black oak, the tamarack, the Norway pine, the chestnut, the American elm, the mockernut and bitternut hickories, the beech, the blue beech, the ironwood, the black cherry, the trembling aspen, the poplar and the paper-bark birch. The endotrophic species were the swamp and sugar maple, the basswood, the horse-chestnut, the walnut, the butternut, and the sycamore. The trees grew in Michigan in the vicinity of Ann Arbor.

L. H. Pennington ‡ has also studied mycorhiza with a view to identifying the fungi that are associated with the tree-roots. He traced the connection between *Russula emetica* and red oak. A species of *Boletus* with a yellow stem and yellow mycelium was also identified in association with the roots of a tree; the yellow strands were like rhizomorphs and were traced down to the roots and to small yellow sclerotia in the soil. Another fungus with yellow mycelium, *Tricholoma transmutans*, was found to form the mycorhiza of the black oak; the mycelial threads were very abundant and were always found thickly clustered about the roots and connected with a felt of ectotrophic mycorhiza.

L. Petri § reports a long series of observations on the mycorhiza of olive trees. Several members of the Oleaceæ have no fungus on their rootlets, others have occasional mycorhiza. In the genus *Olea* there is also great diversity, but in most of them the endotrophic form is more or less constant. On the whole there is less development of the root fungus in heavily manured or in damp situations, while in a dry locality it is very abundant. In the interior of the roots the mycelium is at first intercellular; later the walls of the host-cells are pierced and it becomes intracellular. Occasionally large vesicles are formed in the inner cortex, and this phenomenon is specially marked in olive trees that have suffered from a fungoid disease of the leaves caused by *Stictis Panizzei*. Further he notes that mycorhiza is rare where there is abundance of nutritive salts in the soil. In such soil the development of the roots is rapid, especially at the stage of most active vegetation, and in such conditions the higher plant becomes independent of the endophyte.

* Abh. Nat. Ver. Bremen, xix. 3 (1908) pp. 271–412. See also Bot. Centralbl., cx. (1909) pp. 308–9.

† Tenth Rep. Mich. Acad. Sci. (1908) p. 46. ‡ Tom. cit., 47–49.

§ Atti Reale Accad. Lincei, cccv. (1908) pp. 754–63 (3 figs.).

Some Aspects of the Mycorhiza Problem.*—B. C. Gruenberg gives an historical sketch of our knowledge of mycorhiza and of the literature published on the subject. He discusses some of the problems connected with the fungus: its importance to the symbiotic plants, its special function in regard to such plants as *Corallorhiza*, Orchids, etc. He suggests the practical bearing of these problems on transplanting of trees, reforestation, tuberisation, nitrification of the soil, etc.

BUBAK, FR.—**Ein kleiner Beitrag zur Pilzflora von Niederösterreich.** (A small contribution to the fungus-flora of Lower Austria.)
[Thirty-six species of microfungi are listed, with localities.]
Ann. Mycol., vii. (1909) pp. 59–62.

DIEZ, JUAN LUIS—**Datos para la flora micologica de la region meridional de España.** (Contribution to the mycological flora of Southern Spain.)
[A list, with notes of some of the larger fungi.]
Bull. Soc. Hist. Nat., ix. (1909) pp. 95–100.

GIBBS, T.—**Bovistella paludosa** Lév.
[A puff-ball new to Britain.] *Naturalist*, Dec. 1908, p. 457.

HENNINGS, P.—**Exogone Kaiseriana g. et sp. n.**
[An Ascomycete new to science, near to *Gymnodiscus*.]
Verh. Bot. Ver. Prov. Brand, l. (1908) pp. 129–31 (with fig.).
See also *Hedwigia*, xlviii. (1909) Beibl. p. 105.

" " **Einige märkische Pezizeen.**
[Description of new species of *Peziza*.] *Tom. cit.*, pp. 132–4.

" " **Asterostroma cellare sp. n.**
[Discovered on damp boards of a house, probably to be found in the open.] *Tom. cit.*, pp. 135–6.
See also *Hedwigia*, xlviii. (1909) Beibl. p. 106.

JAAP, O.—**Weitere Beiträge zur Pilzflora der nordfriesischen Inseln.** (Further contributions to the fungus flora of the North Frisian Islands.)
[The species collected were mostly parasites on the higher plants. Some of them are new to science.]
Schrift. Nat. Ver. Schles.-Holst., xiv. 1 (Kiel, 1908) pp. 15–33.
See also *Bot. Zeit.*, lxvii. (1909) p. 60.

KOORDERS, L. H.—**Ueber Wiesneriomyces.**
[On *Wiesneriomyces*, a new genus of Tuberculariaceæ-Phragmosporæ, discovered in Java.] *Wiesner. Festschr.* (Wien, 1908) 329–31 (1 fig.).
See also *Centralbl. Bakt.*, xxii. (1908) p. 464.

MAGNUS, P.—**Eine neue Tilletia aus Serbien.** (A new *Tilletia* from Servia.)
[Found on the flowers of *Bromus*.]
Hedwigia, xlviii. (1908) pp. 145–6 (7 figs.).

MURRILL, W. A.—**The Boleti of the Frost Herbarium.**
[Review and re-determination of specimens.]
Bull. Torrey Bot. Club, xxxv. (1908) pp. 517–26 (5 pls.).

PECK, C. H.—**New Species of Fungi.**
[Diagnoses of species from Massachusetts, Kansas, etc.]
Op. cit., xxxvi. (1909) pp. 153–7.

PETCH, T.—**The Genus Endo calyx Berk. and Br.**
[A genus probably more suitably placed in Phæostibeæ than in Melanconiæ. Three species are described.] *Ann. Bot.*, xxii. (1908) pp. 389–400 (1 pl.).

* Bull. Torrey Bot. Club, xxxvi. (1909) pp. 165–9.

SARTORY, A.—**Sterigmatocystis insueta Bainier.**
[Biological characters and pathogenic properties of the fungus. Descrip- of various experiments of culture and of inoculation.]
Bull. Soc. Mycol. France, xxiv. (1908) pp. 221–9 (1 pl.).

SEAVER, J.—**Some North Dakota Hypocreales.**
[The species collected are published with notes on habitat, etc.]
Bull. Torrey Bot. Club, xxxv. (1908) pp. 527–33.

SEVERINI, GIUSEPPE—**Primo contributio alla conoscenza della flora micologica della Provincia di Perugia.** (First contribution to the knowledge of the mycological flora of Perugia.)
[Special attention is given to plant diseases.]
Ann. Bot., vi. 2 (1907) pp. 277–303.
See also *Ann. Mycol.*, vi. (1908) p. 460.

SPEGAZZINI, C.—**Hongos de la Yerba Mate.** (Fungi of Yerba Mate.)
[The diseases that attack the Mate shrub, *Ilex paraguayensis*, five of them due to fungi. The new genera described are *Aeanthonitschkea*, *Stilbopeziza*, *Macrodiplodiella*, *Phæomarsonia*, *and Spermatoloncha*.]
An. Mus. Nac. Bueno Aures, xvii. (1908) pp. 111–41.
See also *Hedwigia*, xlviii. (1908) Beibl. p. 67.

THEISZEN, F.—**Xylariaceæ austro-brasilienses.** (*Xylariæ* of Southern Brazil.)
[A revision of the group, with notes and diagrams.]
Ann. Mycol., vii. (1909) pp. 1–18.

TURCONI, M.—**Intorno alla micologia Lombarda. I.** (The mycology of Lombardy).
[The species dealt with number 1970.]
Atti Int. Bot. Univ. Pavia, ser. 2, xii. (1908) 57 pp.
See also *Hedwigia*, xlviii. (1908) Beibl. p. 60.

WILSON, GUY WEST—**Studies in North American Peronosporales. IV. Host Index.**
[The index is arranged in alphabetical order within the different natural orders.] *Bull. Torrey Bot. Club*, xxxv. (1908) pp. 543–54.

WOLFF, J.—**Sur quelques propriétés des oxydases de Russula delica.** (Some new properties of the oxydases of *Russula delica*.)
[Notes of physiological experiments.]
Comptes Rendus, cxlviii. (1909) pp. 500–1.

Mycetozoa.

(By A. LORRAIN SMITH, F.L.S.)

Myxomycetes of the Jura.*—Ch. Meylan has made a continuous study of these organisms in the Jura mountains, and now publishes his list of species with notes. He found a considerable number of snow-species, several of them entirely confined to mountainous regions. There is an absence of dead leaves in these hilly regions, and in consequence the species that grow in these altitudes are very rare. Meylan describes a new species of *Didymium* and of *Reticularia*.

Myxomycetes of Aigonal.†—J. Lagarde made a study of the biological conditions that influenced the occurrence of different species of fungi at Aigonal in Lozère, and he adds a list of Myxomycetes that were found there. There are nine genera with as many species represented, but the author explains that no special study was made of the group.

* Bull. Soc. Vaud., xliv. (1908) pp. 285–302.
† Bull. Soc. Mycol. France, xxix. (1908) p. 218.

Schizophyta.

Schizomycetes.

Bacteroids of Bacillus radicicola.*—R. E. Buchanan finds that the morphology of *B. radicicola* varies in artificial media according to the nutrient employed; sodium succinate causes the most luxuriant growth and produces the greatest varieties of bacteroids; glycerin especially favours the development of bacteroids; peptones inhibit growth and production of bacteroids; of fifteen carbo-hydrates tested all favoured the development of bacteroids, and especially mannite. *B. radicicola* in leguminous roots shows the same type of bacteroid as may be found in suitable culture media. Probably the term *B. radicicola* includes a closely related group of varieties differing from each other to some degree in morphological characters.

The author considers that the nodule organism resembles in its morphology both yeasts and bacteria, and that the difference of this form and those included under the terms "bacillus" and "pseudomonas" justify the use of the generic name "Rhizobium."

Bacillus radicicola.†—O. M. Ball finds from a number of observations on soils that *B. radicicola* can remain active for very long periods in soil devoid of leguminous vegetation, and even in air-dry soil. The organism diffuses at a considerable rate through soils that are in proper condition. To secure the bacteria in a soil lacking them, if there is any such, one need only to ascertain the cause preventing their appearance, and remove the disturbing factor.

Oospora buccalis.‡—H. Roger, L. Bory, and A. Sartory have in a case of tonsilitis isolated this organism from the white patches on the buccal mucous membrane and also from the pus of the tonsilar abscess, which contained exclusively filaments of *Oospora*. Pure cultures were obtained in maltose broth; hanging drops from this showed straight non-motile filaments of various lengths, and $0 \cdot 7$–$0 \cdot 8\,\mu$ in width; when older they become sinuous and wavy, and have irregularly distributed lateral branchings; on the fourth to fifth day the conidia commence to appear as small hoops, which later become oval and spherical; the filaments segment into ovoid bodies, probably arthrospores, which at the end of thirty-six hours at 32° to 35° C. give rise to small filaments which soon assume the adult form; in the old cultures, the filaments which were previously hyaline and homogeneous, become granular, and the branches disappear.

Aerobic and Anaerobic Growth.§—A. Meyer notes that the oxygen requirements of organisms is most exactly expressed by three cardinal points of oxygen concentration; if spores are submitted to lower and lower concentration of oxygen, a point is at last reached at which they no longer germinate, though the potential power of germinating remains; this point is the minimum oxygen concentration for spore

* Centralbl. Bakt., 2te Abt., xxiii. (1909) p. 59.
† Tom. cit., p. 47.
‡ C.R. Soc. Biol. Paris, lxvi. (1909) p. 301.
§ Centralbl. Bakt., 1te Abt. Orig., xlix. (1909) p. 305.

germination. The optimum oxygen concentration is that point at which germination most rapidly occurs; the maximum oxygen concentration is the greatest the organism can withstand. The author arranges bacteria into groups according to their behaviour to different oxygen concentrations. For spore germination and growth these cardinal points of oxygen concentration are very similar, but for spore formation there is much variation. Thus, *B. mycoides* shows an optimum growth and spore germination with a concentration of 70 mg. of oxygen per 1000 c.cm., a maximum concentration of 1336 mg. of oxygen, whereas a minimum concentration of 4·3 mg. per 1000 c.cm. is essential. If the spore formation of the same organism is considered, the minimum concentration is 6·8 mg., the optimum 267 mg., and the maximum 1336 mg. of oxygen per 1000 c.cm. of surrounding atmosphere.

Organism of "Phlegmon emphysemateux."*— V. and A. Babes have isolated an organism from the body of a man who had died after an operation for external urethrotomy. Various parts of the body were much distended with gas, and showed necrotic foci; microscopic examination showed the presence of a large bacillus in enormous numbers. The bacillus, which measured 3–6 μ by 1 μ, was non-motile, and contained varying sized oval formations, corresponding to spores; when stained by Gram's method it presented a red axial thread, on either side of which is a pink zone limited externally by a broad blue peripheral portion; the organism is anaerobic, and produces large gas bubbles on glucose agar; it only grows in the depth of the medium, which is broken up by the gas developed. Inoculation into rabbits caused only a small emphysematous swelling, which disappeared the next day. The authors consider that the organism is identical with that described by Fraenkel as *B. phlegmonis emphysematosus*. There appeared to be no doubt that this organism was the cause of the local lesion, and that, being transported to different organs, a fatal general infection was established.

Anaerobic Flora of the Mouth.†—G. Repaci has isolated in pure culture from the mouth of a healthy man an organism which morphologically and biologically resembles *Bacillus fusiformis*, which was described by Vincent as occurring in symbiosis with spirilla. The bacillus has pointed ends, and varies in length from 10–5 μ; it stains by ordinary dyes, but not by Gram's method; it is non-motile; it does not form spores; it is a strict anaerobe. At 37° C. it appears on glucose agar after 18–24 hours, as small round, opaque, grey points; these increase in size to 2 mm. diameter, and exhibit a central salmon-coloured nucleus surrounded by a grey zone: there is no production of gas, but the media give off a disagreeable odour. The author states that the organism grows on gelatin at 37° C. without causing liquefaction, and without clouding the medium, but forming an abundant deposit; it ferments glucose, lactose, and dextrose: it grows in milk, producing acid, but not coagulation; it produces indol in peptone broth; it is pathogenic for guinea-pigs and mice.

* C.R. Soc. Biol. Paris, lxvi. (1909) p. 324. † Tom. cit., p. 596.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Bausch and Lomb's Petrographical Microscope Stand L C H.†—This instrument (fig. 60) is intended to combine convenience of manipulation with completeness of equipment. The excellence of the same makers' L C stand included Nicols of extra quality and size in addition to a special illuminating device. The present instrument combines these features with the lever fine-adjustment and handle-arm, the latter being so placed as to give 75 mm. to the centre of the stage. The stage itself is circular, and measures 90 mm. inside, and 102 mm. outside; the graduations, which are in single degrees, are read by convenient vernier. The stage-plate has a vulcanite top, and is provided with spring-clips and centring-screws; it has two scales at right angles to each other, graduated in millimetres. The plane-stage may be removed and the revolving mechanical stage substituted. This mechanical stage can be completely rotated, and is graduated similarly to the plane-stage; it is designed to carry the size of slides usually used in petrographical work. The holders are adjustable. Both movements are fitted with verniers and graduations for recording the field. The substage has a mounting for the polariser or Abbe condenser, and is focused by an accurate rack-and-pinion of long range; the polariser may be swung out of the optical axis when desired. The body-tube is of fixed length and is slotted for the Bertrand lens, beneath which an iris diaphragm is mounted, so that the image of

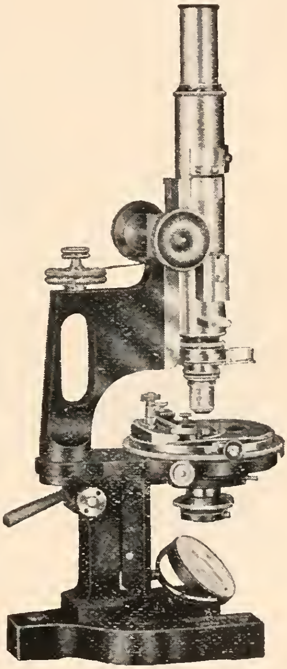


Fig. 60.

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives: (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Bausch and Lomb Optical Co., Rochester, N.Y., Catalogue, Microscopes and Accessories, p. 46.

the interference figures may be made sharp. The lens may be focused by a small rack-and-pinion attached to the body-tube. The prism-box is adjustable, so that the analyzer may be removed from the optical axis when not used. A slot, which may be closed, is provided for the quartz-wedge, gypsum-plate, red of first order, or a $\frac{1}{4}$ undulation mica plate. The coarse-adjustment is by rack-and-pinion. The micrometer screw-head of the improved lever type of the fine-adjustment is divided to give two speeds, and the larger part is graduated into one hundred divisions, each one equal to 0·005 mm. in vertical movement; the indicator is hinged. The polariser is a large Nicol prism in a revolving mount graduated in single degrees and read by a fixed pointer. A stop indicates the zero position, and an iris diaphragm is attached below the prism. The polariser is used in the substage. A large Nicol prism, mounted in a prism-box sliding in the body-tube, acts as the analyzer. The illuminating apparatus consists of a two-lens condenser so as to give converged polarised light. The upper lens is mounted in a metal hemispherical shell, so attached to the mounting of the polariser that it may be instantly thrown in or out of the optical axis without disturbing any of the other parts; it is operated by a conveniently placed lever.

Watson and Sons' Porro-prism Erector for Dissecting Microscopes.*
This apparatus (fig. 61) fits the firm's Laboratory and Simplex Dissecting Microscopes, and enables ordinary Microscope objectives to be used instead of the usual dissecting type. Greater working distance with high powers is thereby afforded, and, as the image is erect instead of inverted, dissection is facilitated.

Fig. 61.

(3) Illuminating and other Apparatus.

Siedentopf's Dark-ground Illumination.†—For dark-ground illumination with Siedentopf's paraboloidal condenser, the Zeiss firm recommend incandescent gas, spirit incandescent, the Nernst light, or, best of all, the electric light, as sources of light. With the aid of a spherical flask K (fig. 62), placed at a distance of about 15 cm. between the source of light B, and the plane mirror of the Microscope M, an image of the source of light is projected on the latter, and at the same time effectually prevents injurious heat affecting the specimen under examination. For instantaneous photomicrography of live bacteria, sunlight, projected on to the mirror of the Microscope by means of a heliostat provided with a clockwork motion, is in most cases essential. An exceedingly accurate adjustment of all the component parts is also necessary.

* W. Watson and Sons, Ltd., Catalogue, 1909, p. 69.
† Carl Zeiss, Jena, Special English Catalogue (1907) Ultra-microscopy and Dark-ground Illumination, part 4, p. 3.

Microscope Illumination.*—E. Giltay describes two forms of lamps which he has found very satisfactory. One lamp is a gas lamp and the other an electric lamp. The gas lamp consists of an erect incandescent mantle flame of the usual form, but raised on a stand so as to be of a convenient height. The stand carries a kind of cage-like framework so contrived that an opaque curtain surrounds the upper part of the lamp. The light which passes upwards through the curtain is ignored, but the light which passes under the curtain is made useful to the microscopist by being made to pass through a slab of ground glass before impinging on the Microscope mirror. The framework also supports an opaque glass shade which serves to reflect on to the glass slab much of

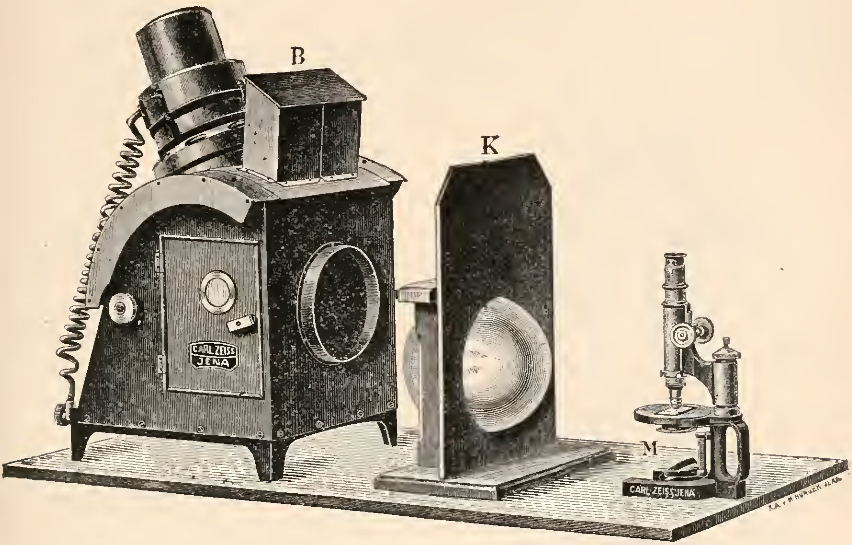


Fig. 62.

the light which would otherwise reach the ceiling. There is provision for inserting more than one slab, so that the same lamp may easily answer the needs of two or several workers, especially if it be set in the centre of a round table.

The electric lamp is an adaptation of one of the new Osram lamps of only 4-volt tension. This is supplied with two accumulators, and has a current of 0·9 ampere. The lamp is clamped on to a pillar mounted on a stand of such a shape that it slides over one of the prongs of the horse-shoe foot of the Microscope and is secured to it by screws. The lamp is thus brought into the usual position of the mirror. The best results were attained with diffused light, the side of the lamp turned upwards having been ground with carborundum powder and a ground glass disk inserted into the diaphragm. This arrangement also secured

* Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 163–8 (3 figs.).

a suitable magnification of the light source. The ground glass disk was made out of the thinnest possible object-glass, and its corners were melted off so that it did not fit quite perfectly over the diaphragm, the purpose being to avoid displacement of the object by air currents which might otherwise intrude between the ground glass and the object slide : this plan gives a ready passage to such air-currents. A copper ring suitably inserted prevents impact of the ground glass disk on to the object slide. The above description applies to a stand fitted merely with a diaphragm and without an Abbe condenser ; but in the case of a stand fitted with a condenser, the above disk must be applied under the condenser lens.

Watson and Sons' Eye-piece Analyser.*—This analyser (fig. 63) fits over the eye-piece, has a large field-prism, and rotates with index against a divided circle.

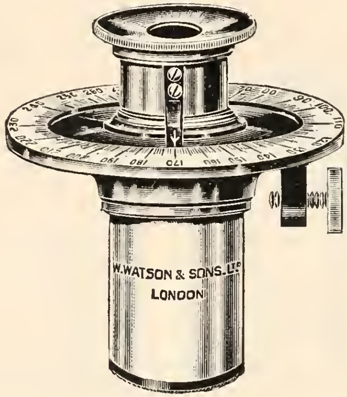


Fig. 63.

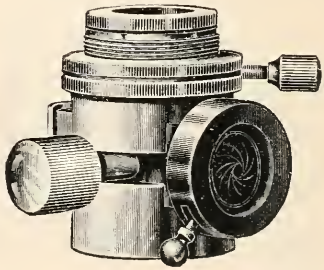


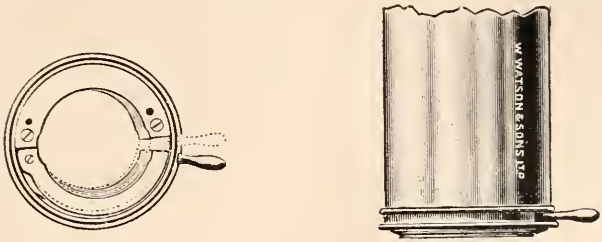
Fig. 64.

Koristka's Illuminator for Opaque Objects.†—This piece of apparatus (fig. 64) is principally intended for the study of metals. It fits into the tube of the Microscope, and contains a totally reflecting prism for receiving lateral light, and reflecting it through the centre of the objective on to the preparation. An iris-diaphragm in front of the prism serves to regulate the incident light. The whole of the prism arrangement with the iris slides in a groove in such a manner that any desired portion of the field can be illuminated, and the best position of the prism ascertained. The light should be directed on the iris by an illuminating lens.

Hall's Grip Nose-piece.‡—This fitting (fig. 65), made by W. Watson and Sons, is placed at the lower end of the Microscope tube, and the objective is slipped into it after pressing the handle. On releasing the

* W. Watson and Sons, Ltd., Catalogue, 1909.
† F. Koristka, Milan, Catalogue xiii. (1908) Microscopi ed Accessori, p. 57.
‡ W. Watson and Sons, Ltd., Catalogue, 1909, p. 110.

handle the objective is firmly gripped. It adds only $\frac{1}{4}$ inch to the length of the body.



A B

Fig. 65.

Stiles' "Universal" Microscope Lamp.*—This lamp, made by W. Watson and Sons, as will be seen from the illustration (fig. 66), will be found very serviceable for Microscopical work.

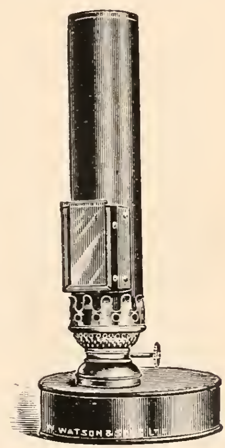


Fig. 66.

(6) Miscellaneous.

Some Hairs upon the Proboscis of the Blow-fly.†—E. M. Nelson recommends a study of the visibility and measurement of the hairs upon the proboscis of the blow-fly as not only an excellent practice in minute microscopical work, but as a very desirable introduction to the more difficult examination of the flagella of bacteria. He classifies four varieties of such suitable hairs:—(1) The minute spinous hairs with filamentous ends upon the upper surface of the membrane of the sucker. 2. Pliant and soft hairs upon the rostrum. 3. Comparatively giant hairs found both upon the rostrum and upon the maxillary palpi. These are five times thicker than the others are long. One measures 0·063 in. in length and 0·002 in. in breadth, while a minute hair measures 0·00044 in. in length and 0·000036 in. in breadth. 4. Tubular blunt-ended hairs 0·0187 in. in length and 0·00036 in. in breadth ranged round the edge of the suctorial disk. The same supply of air which inflates the tongue also inflates these hairs. The object of this is twofold: first, it renders them stiff enough to afford special protection to the delicate edge of the suctorial disk: and, secondly, when the tongue is relaxed they become flaccid and in no way interfere with the folding up of the organ into the head capsule.

Navicula Smithii and N. Crabro.‡—A. A. C. Eliot Merlin, in examining specimens of *Navicula Smithii* from the Bay of Naples, has

* W. Watson and Sons, Ltd., Catalogue, 1909, pp. 122–3.
† Journ. Quekett Micr. Club, 1908, pp. 227–8.
‡ Tom. cit., pp. 247–50.

found that the distinctive diagonal double rows of "pearls" have the primaries crowned with a very beautiful kind of perforated secondary structure which should be within the reach of any good oil-immersion lens capable of standing a large working aperture. The author has also found that *N. Crabro*, a form analogous although differently shaped to *N. Smithii*, and possessing likewise a double row of "pearls," also possesses an exactly similar structure. The specimens, presumably Belgian, figured in Van Heurck (Plate B, fig. 23, and plate ix., fig. 1), do not show these secondaries. It may be that there is a difference in structure between the Belgian and Italian varieties of these diatoms.

Quekett Microscopical Club.—The 456th Ordinary Meeting was held on April 2, Mr. C. F. Rousselet, F.R.M.S., Vice-President, in the Chair. Mr. C. Lees Curties, F.R.M.S., for Messrs. Baker, gave an interesting exhibition of some of the different illuminants for the Microscope. A paper by E. Heron-Allen, F.L.S., F.R.M.S., and A. Earland on "A new species of *Technitella* from the North Sea, with some observations upon Selective Power as exercised by certain species of Arenaceous Foraminifera" was read by Mr. Earland. The new species is *Technitella Thompsoni* sp. n., and is fully described and illustrated in the current Journal of the Quekett Microscopical Club (April 1909). The test is built up entirely of echinoderm plates. Mr. E. F. Law gave a lecture, illustrated with photomicrographs in the lantern, on "The Relation between the Microscopic Structure and Properties of Alloys."

At the 457th Ordinary Meeting held on May 7 the postponed presidential address was delivered by Professor E. A. Minchin, M.A., F.Z.S., who took for his subject "Some Applications of Microscopy to Modern Science and Practical Knowledge." He gave a very interesting account of malaria, sleeping sickness, and yellow fever, describing the life-history, so far as it is at present known, of the parasites causing these respective diseases.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Flask for Fluid Media.†—A. H. Caulfield advises the following modification of the flasks used for holding fluid media by which the wetting of the plug from often unavoidable shaking is obviated. The neck of an ordinary flask is throttled and plugged by a glass ball rather larger than the contriction: this can be readily blown from a piece of small glass tubing, and if provided with a short handle it can be conveniently held in position by the wool plug. The author found this form of flask useful for cultures made on patients living at a distance from the laboratory.

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; 4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, etc.; (6) Miscellaneous.

† Centralbl. Bakt., 1te Abt. Orig., xlix. (1909) p. 463.

(2) Preparing Objects.

Method for Demonstrating Spores of Tubercle Bacilli.*—L. von Betegh employs the following method for demonstrating the spores of tubercle bacilli. Thin smears are prepared, dried, and fixed in the flame ; these are then placed in 10 p.c. nitrate of silver, and heated for one minute at 80°–90° C. (but not allowed to boil), and then thoroughly washed in water ; they are then treated with several drops of freshly made 50 p.c. aqueous solution of rodinal, for 20 to 30 seconds, until they become brown or black-brown ; again washed in water, dried, and mounted. By this means only the spores are stained black-brown, and the organism may be subsequently stained by treating the film with carbol-fuchsin, without warming, for 1–2 seconds.

Hahn, H.—**Apparat zur Einbeltung in paraffin.**
[A sideboard into which is let a tank, with hot and cold water supply, worked through a 3-way tap by means of a pedal. In order to regulate the temperature of the water in the tank, this is divided up by a number of partitions.] *Zeitschr. Wiss. Mikrosk.* xxv. (1908) pp. 184–7 (2 figs.).

(4) Staining and Injecting.

Methods for Staining Tubercle Bacilli.†—A. Cann compares the methods of Ziehl-Neelsen, Much, and Hermann. The methods of Much consist of several modifications of Gram's method ; Hermann's stain is a solution of crystal-violet and ammonium carbonate, and various modifications for this stain when used for sections are suggested. The author finds from the examination of a number of specimens stained by these processes that both the method of Much and those of Hermann compare favourably with that of Ziehl-Neelsen ; that many cases which are negative with Ziehl-Neelsen are also negative with the other methods ; but twice as many cases which gave a positive result with Hermann's methods were negative with Ziehl-Neelsen, and a less number were negative with Much's method. Granules and granular rods are more often demonstrated by the methods of Much and Hermann than by Ziehl-Neelsen.

Masur, A.—**Beiträge zur Histologie u. Entwicklungs-geschichte der Schmelz-pulpa.** *Anat.*, xxxv. (1907) pp. 265–92 (6 pls.).

(5) Mounting, including Slides, Preservative Fluids, etc.

Mounting of Algæ.‡—J. A. Nieuwland calls attention to G. S. West's method of killing, fixing, mounting, and preserving algæ. The fluid used is a 2 p.c. solution of potassium acetate, made just blue with copper acetate. This medium reduces plasmolysis to a minimum. For permanent mounts thick slides should be used, and the coverslip sealed down with gold size several times after each drying.

With *Vaucheria*, plasmolysis is hard to avoid, and the best procedure is to kill rapidly with 3 or 4 p.c. formalin, which must be completely washed out afterwards, or the preparations will turn black. The *Vaucheria* are then removed to 5 to 10 p.c. glycerin, to which a

* Centralbl. Bakt., 1te Abt. Orig., xlix. (1909) p. 461.
† Tom. cit., p. 637.
‡ Bot. Gaz., xlvii. (1909) pp. 237–8.

little thymol is added, and the fluid is then allowed to inspissate by evaporation by placing the vessel near a radiator.

The author's procedure for mounting algæ is as follows: after killing and fixing in the potassium-copper-acetate solution an equal bulk of 10 p.c. glycerin is added; the mixture is then allowed to concentrate by evaporation in a warm place, protected from dust. It is necessary to separate the algæ from all dirt, otherwise a precipitate of copper oxide occurs.

(6) Miscellaneous.

Shake Apparatus.*—A. Wolff-Eisner has devised the apparatus shown in the accompanying figure (fig. 69). It consists of an excentric-

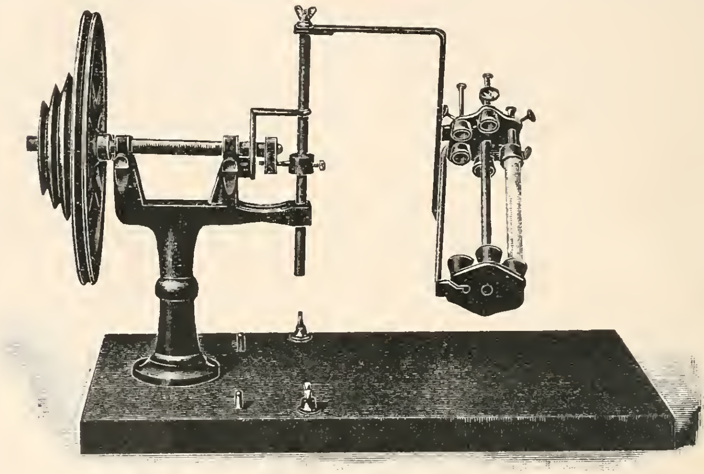


Fig. 69.

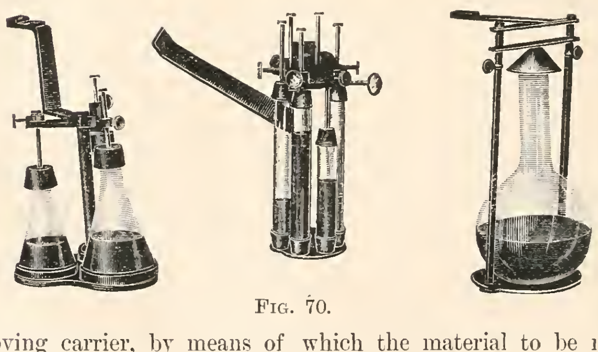


Fig. 70.

ally moving carrier, by means of which the material to be mixed is shaken right and left and up and down at an angle of about 23°, and sideways movement being about 8°. Various holders (fig. 70) are shown for receiving different kinds of flasks and test-tubes. The rotating wheel may be attached to a small motor.

* Centralbl. Bakt., 1te Abt. Orig., xlix. (1909) p. 654.

Metallography, etc.

Platinum-antimony Alloys.* — K. Friedrich and A. Leroux have determined the equilibrium diagram for the range 0–91·3 p.c. platinum. The presence of the following phases in the solid alloys has been established : pure or nearly pure antimony, $PtSb_2$ and Pt_5Sb_2. Pure platinum may exist in the platinum-rich alloys. Pt_5Sb_2 is the product of a reaction occurring in the solid state. Heat-tinting was employed to render visible the micro-structure.

Influence of Manganese on the Iron-carbon System.† — F. Wüst gives a comprehensive account of previous work on iron-manganese alloys, with and without carbon, and describes his investigations on thirty-three alloys, prepared by melting pure cast iron with manganese and an excess of carbon. The alloys contained manganese 0·06–80·45 p.c., carbon 4·03–6·9 p.c. The solidification point of cast iron is somewhat lowered by manganese additions up to 13 p.c. ; it then rises, till at 80 p.c. it is about 1250° C. The "pearlite point" (Ar_1) is lowered by small additions of manganese, and at 5 p.c. disappears altogether. Alloys with more manganese contain no pearlite. Manganese increases the capacity of iron for dissolving carbon, and alters the position of the eutectic point. This point in pure iron-carbon alloys lies at 4·2 p.c. carbon, and at 4·05 p.c. when 15 p.c. manganese is present. The presence of manganese favours the formation of troostite and solid solution. Many of the sections, of which photomicrographs are given, were etched with nitric acid in amyl-alcohol.

Heat-contents of Binary Systems.‡—G. Tammann represents the thermal equilibrium of binary mixtures by means of a three-dimensional model, the base of which is the ordinary temperature-concentration diagram. The height of the surface of the model, at any point, is proportional to the heat content of unit mass. Photographs of models corresponding to different cases are given.

Recalescence Temperatures of Nickel.§—T. A. Lindsay has taken cooling curves of nickel containing less than 2 p.c. of impurities, by the differential method, using copper as the neutral body. In cooling from 900° to 180° C., nickel gives out heat gradually from about 700° to about 285° C. At some points in this range the heat evolution is more rapid, small recalescences occur about 660° C. and 525° C., a larger one from 440°–370° C., and the most marked recalescence from 370°–285° C.

Melting-point Curves of Binary Alloys.‖—D. Mazzotto applies two corrections to the melting-point curve, one depending on the heat of

* Metallurgie, vi. (1909) pp. 1–3 (13 figs.).
† Tom. cit., pp. 3–14 (20 figs.).
‡ Zeitschr. Phys. Chem., lxiii. (1908) pp. 129–40 (16 figs.).
§ Proc. Roy. Soc Edin., xxix. (1908) pp. 57–67 (6 figs.).
‖ Journ. Chem. Soc., xciv. (1908) pp. 660–1. See also Nuovo Cim., xv. (1908) pp. 401–22.

mixture, the other on the association of the dissolved metal. The curves of the bismuth-tin and other series, thus corrected, approximate very closely to the ideal curves. The presence of a solid solution or a chemical compound renders the method inapplicable.

Alloys of Iron and Carbon.*—G. Charpy reviews recent work on the iron-carbon system, and discusses the application of the various methods of investigation to the construction of the equilibrium diagram.

Ultra-microscopic Observations.†—J. Reissig describes the ultra-microscopic examination of colloidal solutions of brown tellurium, selenium, and silver, and of red and blue gold. The stability of the colloidal gold, indicated by the slowness with which flocculation takes place on addition of hydrochloric acid, is greater in dilute than in concentrated solutions.

Freezing-point of Iron.‡—H. C. H. Carpenter states briefly the present condition of high temperature pyrometry, and gives an account of the determinations which have been made, of the freezing-point of iron. This point is best defined either on the thermo-electric or the optical scale. The mean value of several closely agreeing determinations by different workers is 1505° C. on the thermo-electric scale, corresponding to 1519° C. on the optical scale, which is probably more nearly the true value. The freezing-point is independent of the atmosphere in contact with the iron.

Constitution of Carbon Steels.§—E. D. Campbell gives an account of the commonly accepted views as to the nature of the constituents of steel, and describes some experimental work on the separation of carbides from a 1·17 p.c. carbon steel by electrolysis in a neutral solution of ferrous sulphate. The carbide separated from the steel quenched in water from 900° C. corresponded to the formula $C_{10}Fe_9$, while the steel in the troostitic condition resulting from reheating to 350° C. after quenching in water from 900° C. gave a carbide with the approximate empirical formula CFe_2. The author suggests the possibility of the existence of a number of carbides of iron in addition to the well-known Fe_3C.

Influence of Thermal Treatment on Linear Deformations of Steels.‖—Demozay gives at some length the results of experiments on the effect of heat treatments, such as quenching in oil and in water, and annealing at a high temperature, upon the breadth and thickness of bars (dimensions originally 100 × 10 × 5 mm.), of 7 steels of carbon 0·19–1·15 p.c. Each treatment was repeated a number of times. Repetition of a treatment accentuates the deformation, which increases in proportion to the number of treatments.

* Journ. Chem. Soc., xciv. (1908) pp. 697–8. See also Bull. Soc. Chim., iii. (1908) pp. 1–46.

† Tom. cit., pp. 933–4. See also Ann. Physik, xxvii. (1908) pp. 186–212.

‡ Journ. Iron and Steel Inst., lxxviii. (1908) pp. 290–9.

§ Tom. cit., pp. 318–35.

‖ Rev. Métallurgie, vi. (1909) pp. 413–41 (44 figs.).

Simple Apparatus for Micrography.*—G. Revol describes an inexpensive Microscope suitable for the examination of metal surfaces in the workshop.

Alloys of Iron with Sulphur.†—Ziegler gives a lengthy description of the microstructure of iron-sulphur alloys containing 0–30 p.c. sulphur, and also of alloys containing varying amounts of carbon, manganese, etc., in addition to the sulphur. In the iron-sulphur system two constituents only were observed, ferrite, and the eutectic iron-sulphide of iron. The compound structure of the eutectic is visible only when the alloy has been slowly cooled. Oxygen may be present as an impurity in the eutectic. The addition of moderate amounts of carbon to the alloy causes pearlite to appear, but does not otherwise affect the structure. Troilite, the constituent containing the sulphur in meteorites, appears to be a similar eutectic, but probably contains some oxide in addition to the iron and sulphide of iron. The structure of most of the alloys was visible after polishing, but was more clearly revealed by etching with picric acid in alcohol, either a 5 p.c. or a saturated solution.

Metallography of Quenched Steels.‡—C. Benedicks presents some criticisms of the conclusions reached by Kourbatoff and by Maurer.§ It is possible that austenite undergoing transformation into troostite always passes through the martensite stage. The existence of a reversible transformation at 137° C., austenite $\rightleftarrows$ troostite, is not probable.

National Physical Laboratory. —The annual report contains much matter of interest. The following points in the report on the metallurgical department may be noted. The great complexity of the equilibrium diagram of the ternary system, copper-aluminium-manganese, has necessitated the restriction of its investigation to the region 0–10 p.c. manganese and 0–12 p.c. copper. A peculiarity, as yet unexplained, has been noted in a small group of the alloys prepared. The freezing-point of one of these alloys remelted several weeks after its preparation is lower than that of the freshly-made alloy. An improvement has been effected in the ultra-violet photomicrographic apparatus by the introduction of a "compensating lens" into the optical system of the Microscope. If the image is visually in focus with blue lights the compensating lens being used, the ultra-violet image is photographically in focus when the compensating lens is removed. Good definition has been obtained in ultra-violet photomicrographs at 400 diameters, but serious obstacles, arising chiefly from internal reflections, have been met at higher magnifications.

A series of determinations of "temperature-density" curves has been made. The work projected for the current year includes further investigation of the alloys of copper and aluminium with manganese,

* Rev. Métallurgie, iv. (1909) pp. 442–5 (3 figs.).
† Tom. cit., pp. 459–93 (22 figs.).
‡ Tom. cit., pp. 494–501.
§ See this Journal, 1908, pp. 783–4.
‖ Nat. Phys. Laboratory, Report for 1908.

nickel, and zinc, and a continuation of the study of the crystalline structure and mode of solidification of eutectic alloys.

Platinum-lead Alloys.*—N. A. Puschin and P. N. Laschtschenko have studied this system by the electric potential method, and have found two compounds, PbPt and Pb_2Pt. The existence of these compounds was confirmed by microscopic examination of the alloys.

Alloys of Silicon.—S. Tamaru† has investigated the silicon-tin, silicon-lead, and silicon-thallium systems. Silicon does not mix in the molten state with either lead or thallium, but mixes in all proportions with tin. There are no compounds in the silicon-tin system. The three equilibrium diagrams are given.

R. Vogel ‡ finds that magnesium and silicon are miscible in all proportions in the liquid state, form one compound Mg_2Si, two eutectics (42 and 96 p.c. magnesium), and no solid solutions. Mg_2Si melts at 1102° C. The equilibrium diagram deduced from the thermal data, and confirmed by microscopic examination, is given. Dilute hydrochloric acid was used for etching.

Silicon-magnesium System.§—P. Lebeau and P. Bossuet conclude from microscopic and chemical evidence that $SiMg_2$ is the only compound that silicon forms with magnesium. The alloys were prepared by melting magnesium filings with crystals of silicon, a small quantity of potassium fluosilicate being added, or by heating magnesium with a mixture of fluosilicate of potassium and magnesium. Alumina was used for polishing, but scratches could not be avoided. Alloys containing little silicon were observed to be grains of magnesium surrounded by a eutectic. At about 2 p.c. silicon, crystals of a silicide began to appear, and the 36·15 p.c. silicon alloy consisted wholly of this silicide. With further increase of silicon another eutectic appeared, and alloys with more than 50 p.c. silicon were observed to contain crystals of free silicon. The structure of many of the sections was visible after polishing, while dilute hydrochloric acid was used for etching others. The composition of the silicide was established by analysis of crystals isolated by dissolving out the magnesium in a 25 p.c. Si alloy with ethyl iodide in anhydrous ether.

Alloys of Manganese.‖—G. Arrivaut has applied chemical methods to the study of the binary alloys of manganese with numerous other metals. The alloys were prepared from pure materials in magnesia crucibles by the aluminothermic process or by melting the metals together in the absence of air. The alloys were treated with various reagents (acids, alkalies, etc.) in such a way that only the manganese was dissolved, the other metal remaining in the residue. According to the nature of this residue the alloys are divided into two classes: (1) those from which one or more constituents corresponding to simple

* Zeitschr. Anorg. Chem., lxii. (1909) pp. 34–9 (1 fig.).
† Tom. cit., pp. 40–5 (3 figs.). ‡ Tom. cit., pp. 46–53 (7 figs.).
§ Rev. Métallurgie, vi. (1909) pp. 273–8 (8 figs.).
‖ Mém. Soc. Sci. Phys. Nat. de Bordeaux, ser. 6, iv. (1908) pp. 67–160 (20 photomicrographs).

formulæ could be separated ; (2) those in which the residue consisted of the second metal only, no compound being isolated. The first class includes the binary alloys of manganese with aluminium, silver, molybdenum, chromium, and vanadium, the second class the alloys with cobalt, nickel, copper, tungsten, lead, platinum, zinc, cadmium, tin, bismuth, and antimony. Some observations on the remarkable magnetic properties of the manganese-bismuth, manganese-tin, and manganese-antimony alloys are recorded. The author fully recognises the provisional character of the deductions drawn as to the number and formulæ of the compounds existing in each system.

New Form of Pearlite.*—C. A. F. Benedicks describes as "bead pearlite" an intermediate form between laminated pearlite and the coarse granular pearlite which is obtained by annealing laminated pearlite below the critical temperature. The new form was observed in grey Swedish pig-iron after heating to 670° C., and disappeared on further heating. The structure of the "bead pearlite" appears to indicate its formation by a partial coalescence of the thin lamellæ of laminated pearlite into larger masses.

Heat-treatment of Steel.†—A. Campion describes the elementary properties of steel upon which heat-treatment is based. Time of heating and mass are possibly the most important factors, apart from temperature, in determining the structure and properties of the material.

ARRIVAUT, G.—**Alloys of Copper and Manganese.**
Procès-verbaux des séances de la Société des Sciences physiques et Naturelles de Bordeaux, 1907–8, pp. 142–3.

„ „ **Arsenides of Manganese.** *Tom. cit.*, pp. 159–62.

DUCELLIEZ, F.—**Cobalt-lead Alloys.** *Tom. cit.*, pp. 31–4.

„ „ **Action of Heat on a Mixture of Arsenic and Cobalt.** *Tom. cit.*, pp. 57–73.

„ „ **Cobalt-antimony Alloys.** *Tom. cit.*, pp. 175–87.

VIGOUROUX, E.—**Nickel-lead Alloys.** *Tom. cit.*, pp. 28–30.

„ „ **Action of Arsenic on Nickel.** *Tom cit.*, pp. 48–56.

„ „ **Siliciuration of Iron and Manganese.** *Tom. cit.*, pp. 78–80.

„ „ **The Arsenides NiAs and Ni_3As_2.** *Tom. cit.*, pp. 137–41.

„ „ **Arsenides of Iron.** *Tom. cit.*, pp. 155–8.

„ „ **Antimonides of Nickel.** *Tom. cit.*, pp. 169–74.

VIGOUROUX, E., & SANFOURCHE—**Arsenides of Chromium.** *Tom. cit.*, pp. 144–50.

„ „ „ **Arsenides of Silver.** *Tom. cit.*, pp. 163–8.

ROSENHAIN, W., & P. A. TUCKER—**Eutectic Research. No. 1. Alloys of Lead and Tin.**
[A more complete account of the work described in the paper summarised in this Journal, 1909, p. 117.]
Nat. Phys. Laboratory, Collected Researches, v. (1909) pp. 83–118 (42 figs.). Reprinted from *Phil. Trans. Roy. Soc.*, A 209 (1908).

* Iron and Steel Times, i. (1909) pp. 135–8 (5 figs.).
† Tom. cit., pp. 157–66 (14 figs.).

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 21ST OF APRIL, 1909, AT 20 HANOVER SQUARE, W.
E. J. SPITTA, ESQ., M.R.C.S., ETC., VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of March 17, 1909, were read and confirmed, and were signed by the Chairman.

A large Binocular Microscope, with accessories, presented to the Society by Lord Edward Spencer Churchill, was described by Mr. Rousselet as being one of Ross's best; made in 1888, having a rotating stage, with rectangular mechanical movement, a swinging sub-stage, fine-adjustment on the right side of the eye-piece of a peculiar form made by Ross only. Three apochromatic objectives by Zeiss, with compensating eye-pieces, polariser, and various other apparatus, all inclosed in a large box made out of the case of an old piano. It was a very fine and complete Microscope, and would be very valuable to the Society.

The Chairman was sure it would be the wish of all Fellows present to return a very hearty vote of thanks to Lord Churchill for this very handsome Microscope. A considerable change had come over the manufacture of Microscopes since this one was made. At that time a man did not consider himself at all well treated unless he had something very large for his money, sometimes too large to be easily manipulated. It was thought, indeed, that a Microscope could not be really a good one unless it was a large one. All this has changed in recent years, and portability as well as efficiency are combined, although it must be allowed the modern instrument is not so grand to look at as those made many years ago, which, in consequence of their elaboration, were exceedingly expensive. This, then, must be looked upon as a very costly gift, for which the Society, he felt sure, would wish to express their gratitude, as it would certainly be of much service at their Meetings. He felt equally certain, too, that those present not only thanked the donor for the gift itself, but also for the kindness which prompted the giver.

The motion having been put to the Meeting was unanimously carried by acclamation.

Mr. Edward Heron-Allen, F.L.S., F.R.M.S., read a very interesting paper "On the Recent and Fossil Forminifera of the Shore-sands of Selsey Bill, Sussex," which was illustrated by about 50 lantern slides of very excellent character, the special features referred to by the Author being pointed out upon the screen by Mr. Earland.

The Chairman, in asking for remarks upon the subject, said that he was sure all would agree that they had had a most interesting and instructive paper, one of that kind the bare reading of which could give them no idea of the amount of work involved in so completely working out the subject. He should look forward to the pleasure of reading it in the Journal, especially the introduction, which gave them such an excellent idea of the means by which the results recorded had been classified. He was sure also that all present would agree that they had had a very magnificent exhibition of lantern slides, most of which were exceedingly good. He should, however, like to ask what was the magnification of the objects on the slides ; were they all the same scale? because, unless they knew this, they could not so well appreciate the difference in size of the objects as they appeared seriatim upon the screen.

Mr. Arthur Earland pointed out that no uniform scale had been adopted, because the objects themselves differed so greatly in size that whilst some would appear gigantic, others would be invisible upon the screen, and the magnifying power under which the photographs for these particular slides were taken, varied according to circumstances from 20 to 160 diameters.

Mr. Heron-Allen said that though this was necessarily the case with the lantern slides, in the illustrations made for the paper the objects would all be shown on the same scale.

The Chairman was glad to hear that a uniform scale had been adopted for the illustrations, as he had always regarded it as a matter of importance that when illustrations were given of microscopic objects, the scale on which they were taken should be indicated.

A hearty vote of thanks to Mr. Heron-Allen for his interesting and instructive paper was unanimously carried.

Mr. E. J. Sheppard, F.R.M.S., read a paper "On the Disappearance of the Nucleolus in Mitosis," the subject being illustrated by photographs and drawings on the board—also by four examples, three vegetable and one Epidermis of Tadpole, exhibited under Microscopes in the room. It was mentioned that the photographs had been taken with a $\frac{1}{12}$-in. oil-immersion objective, except in one case where a $\frac{1}{8}$-in. objective had been used.

Prof. E. A. Minchin, in reply to the invitation of the Chairman to make some remarks upon the paper, said he had listened with great interest to the author's statements, but disclaimed any special knowledge of the subject, upon which much had been written and many different views had been put forward.

Mr. Sheppard said that the processes which he had drawn upon the board, were, in comparison with the number of cells, rather few, but their association with the chromosomes showed that the nucleolus was absorbed or taken up by the chromosomes. It would be found, upon careful observation, that these threads or nucleolar projections were actually in contact with the chromatin thread or granules, and apparently become visible at an early stage of the spireme formation.

The Chairman was sure the Fellows present would be very pleased to return their best thanks and congratulations to Mr. Sheppard for his excellent paper, so full of instruction and comment. As he had previously pointed out, these original investigations involved a great deal of work and much continued energy which were in no way commensurate with the length of a paper; indeed, in one instance with which he was acquainted, the summary of five years' close work was condensed into but little more than a sheet of foolscap. It was not easy to pass remarks on any new matter without reading the author's remarks in the Journal, so he had but little to say upon the subject in question, but he felt sure those present would show their esteem in the usual manner.

The thanks of the Society were unanimously voted to Mr. Sheppard for his paper.

Mr. Heron-Allen said he had found in his slide box, a slide which had been made to illustrate a paper recently read by himself and Mr. Arthur Earland before the Quekett Microscopical Club, and which he was glad to be able to show on the screen, as it represented the most remarkable powers of selection of material hitherto encountered in the study of the arenaceous Foraminifera. It represented a new species called *Technitella Thomsoni* (Earland), dredged by Mr. Earland in the Moray Firth. In this case the creature had formed its test entirely of the spicules of a particular kind of Echinoderm, and though there were no doubt plenty of these at the bottom of the sea in proportion to the grains of sand and other material to be found in the same area, the number of these plates was infinitesimal; yet this Rhizopod went about, and in the most remarkable way, selected only these for its purpose. The slide in question was then shown upon the screen.

Mr. J. W. Gordon said he should like to mention that the next meeting of the "Brass and Glass" section would take place on the 28th of April, when Mr. Cheshire had arranged for a demonstration of the optical parts of a Petrological Microscope, and contributions of apparatus relating to this branch of microscopy would be particularly valuable on that occasion.

It was announced that at the next Ordinary Meeting of the Society, on May 19th, there would be an exhibition of "Pond Life."

The following Instruments, Objects, etc., were exhibited :—

The Society :—Large Microscope, made by Ross in 1888, presented by Lord Edward S. Churchill.

Mr. Edward Heron-Allen and Mr. A. Earland :—Lantern slides and the following mounted specimens in illustration of their paper : *Articulina foveolata* sp. n.; *Bigenerina conica* sp. n.; *B. selseyensis* sp. n.; *Cornuspira selseyensis* sp. n.; *Saccammina sphærica; Spiroculina foveolata; S. pertusa; Webbina hemisphærica;* three slides of

Foraminifera from Post-Pliocene Mud, opposite Medmerry Farm, Selsey Bill; ditto from Shore Sand, opposite the Bungalow, Selsey Bill; Pyritised Casts of Forams and Ostracods from Blue Band, Pholas Bed, Selsey Bill.

Mr. E. J. Sheppard:—The following slides in illustration of his paper: Association of Chromosomes around nucleolus, *Allium*; Late disappearance of nucleolus closely associated with chomosome, *Allium*; Fine processes extending from nucleolus to chromatin, *Hyacinthus*; Epidermis of tail of Tadpole.

New Fellows:—The following were balloted for and duly elected *Ordinary* Fellows of the Society:—Messrs. Bernard Hobson Hoole, Charles Richard Mapp, Alfred James Shearsby, and Rev. Frederick William Walter.

MEETING

HELD ON THE 19TH OF MAY, 1909, AT 20 HANOVER SQUARE, W., F. J. CHESHIRE, ESQ., VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of April 21, 1909, were read and confirmed, and were signed by the Chairman.

The List of Donations to the Society, exclusive of exchanges and reprints, received since the last Meeting, was read:—

	From
Worthington G. Smith, British Basidiomycetes. (8vo, London, 1908)	*The Trustees of the British Museum.*
Report of the British Association, Dublin, 1908. (8vo, London, 1909)	*Sir Frank Crisp.*
A Microscope Lamp	*Lord Edward Spencer Churchill.*

The thanks of the Society were voted to the Donors, especially to Lord Edward Churchill for the Microscope Lamp, presented to the Society in addition to the Microscope received at the last Meeting.

A paper by Mr. Edward Heron-Allen and Mr. Arthur Earland "On the Foraminifera of the Shore-sands of Selsey Bill, Sussex"—Part II., was taken as read.

Mr. J. W. Gordon's paper on "A new Illuminator for the Microscope," having been already printed and placed in the hands of some of the Fellows, was not read *in extenso*, but the construction and use of the apparatus were explained to the Meeting by reference to a diagram and by the exhibition of the instrument itself.

The Chairman said he had the pleasure some time ago of examining Mr. Gordon's apparatus, which was undoubtedly a very ingenious device for illuminating objects under the Microscope by means of a light source, which had hitherto been intractable. What especially struck him was the simple and effective way in which the intensity of the light could be regulated as required, without disturbing any focal or aperture adjustment. A well defined circular light-source could of course be obtained from any sufficiently extended flame by the simple expedient of placing a piece of perforated sheet metal in front of it, but the intensity of such a source could not unfortunately be easily and satisfactorily regulated.

Mr. J. E. Barnard said that he gathered from Mr. Gordon's paper that he had discarded the Nernst lamp because of its want of durability. This was an objection when they were first introduced, but they appear to be less subject to this now than formerly. If a Nernst filament runs for the first fifty or sixty hours without fracture, it then appears to enter on a longer life, and will often run for a long period. He had used a 1-ampere Nernst lamp for the last two or three years, and during that period the filament had not been renewed. He used it nearly always for short periods, when it was turned on and off frequently, which was rather a severe test, but it was still working satisfactorily. He thought it was to be recommended as it gave a much greater degree of luminosity per unit area of filament than any carbon or metallic filament electric lamp. As regarded the tubular lamps, they were subject to a very great drop in intensity after having been in use for a time, and he thought if Mr. Gordon could get a carbon lamp in a small tube as suggested, he would find the drop to be very considerable, because the smaller the tube the more rapidly would the lamp deteriorate. He thought it might really be considered that a Nernst lamp would be the best for the purpose.

Dr. Spitta did not agree that Nernst lamps were at all reliable, and he deprecated any attempt to use them on this account. He was speaking of the smallest size, not the half ampere, which in his experience he found much more durable. It was only fair to state, however, that he understood the Company were bringing out a new pattern, which they hoped would be half the price and quite efficient.

Mr. Barnard said he should explain that he had taken the precaution never to run a lamp on the full voltage it was made for, but always reduced this $7\frac{1}{2}$ p.c. to 10 p.c. If this was allowed the lamp was found to work well. The makers suggest that some allowance should be made in this respect, but it is quite practicable to allow a much greater margin than they suggest, with the result that the life of the filament is greater. The only practical objection to this is that the preliminary heating up period is somewhat increased, but this is a small objection for microscopic or similar scientific purposes.

Mr. Wesché thought that for general Microscope work there was nothing better than a good paraffin lamp. While admitting the advantage of the more powerful illumination of electric lamps, he had experienced much waste of time and trial of patience through the breaking of filaments and the failure of fuses.

Mr. Taverner said he agreed with the first speaker, although at first he had had a difficulty with some of the Nernst lamps; but on returning them to the makers, it was found that the trouble was due to their having been incorrectly marked, and, with the exception of the first, all had gone very well. He had only given up the Nernst, because he had adopted an arc light for a stronger light.

Mr. J. Hopkinson recommended incandescent gas as giving a brilliant white light, the intensity of which could be easily modified to any degree without moving the lamp.

Mr. J. Rheinberg said that a very interesting subject that might be discussed in regard to this lamp was as to its suitability for critical images. It was commonly supposed that the different points of a flame bore no phase-relation to one another, and this was supposed, more especially by one school of writers on the theory of microscopic vision—the one to which he believed Mr. Gordon adhered—to be of special benefit as regards critical images. But in the disk source of light which this lamp presented as the source of illumination for the Microscope, all the points were in phase-relation to one another. He himself (i.e. Mr. Rheinberg) saw no objection in that, as he was not an adherent of the views above mentioned, and he thought the new lamp would be quite as suitable for critical images as a flame source, from the theoretical point of view. He would be interested to hear what Mr. Gordon had to say to the point raised.

The Chairman remarked that he, too, had a favourite light to recommend. Some time ago, before the advent of the electric light, public-houses were largely lit up by what was called the albo-carbon gas light, a light obtained by first passing ordinary coal-gas, as a preliminary to combustion, through a vessel containing heated naphthalene. The flame was a large and brilliantly white one.

Mr. Taverner inquired how the lamp could be regulated.

The Chairman said this could be done by cutting off a portion of the light with a metal plate with a circular hole in it. In this way a sharply defined circular source could in effect be obtained.

Mr. Gordon said he should like to say a few words in reply to the observations which had been made. With regard to the remarks of Mr. Barnard and Dr. Spitta, there was, perhaps, not so much conflict as there seemed to be, as it appeared that under certain conditions Nernst lamps worked well, but there were some conditions under which they did not. He had used them on a voltage of 105, and his was also an alternating current; but Mr. Barnard worked with much higher voltage, and possibly on a direct current—this would, of course, be much more favourable to the lamp. His own experience had been much the same as Dr. Spitta's. Mr. Hopkinson had a weakness for the incandescent gas lamp, the objection to which was that they could not get an image of the light-source without getting an image of the mesh of the mantle, unless ground-glass was used, or the source was thrown out of focus. If a Welsbach mantle was thrown out of focus, its image appeared in the Ramsden circle, and formed there the optical equivalent of a thread-like aperture, and giving rise to a very unpleasant amount of diffraction; and under these conditions this kind of lamp impaired all fine detail in the picture. Mr. Wesché favoured the ordinary paraffin lamp, which was a very excellent one within its limits, but of course they could not get a greater intensity of light from it than the specific brightness of the flame permitted, and, compared to the incandescent filaments, its specific brightness was low, whilst if it was thrown out of focus, a great deal of diffraction resulted. Mr. Rheinberg had invited him to a controversy on the subject of the difference of phase, and although a controversy with so genial an opponent was always agreeable, on this occasion he was obliged to decline it, for the reason that he was in entire agreement with Mr. Rheinberg on the point raised. The different parts of a flame were, no doubt, in different phases, but in the Microscope we did not see the actual flame, but its image, and after the light had passed through a condenser the beams from different points in the flame would have so modified one another that adjacent antipoints in the image would be by no means independent of one another in respect of phase. This is pointed out in one of Lord Rayleigh's papers, and he, the speaker, thought that the interdependence of the various parts of the image in respect of phase might be put even higher than Lord Rayleigh puts it in that paper.

Mr. Heron-Allen said that at the last Meeting of the Society he had exhibited on the screen a large number of lantern slides representing species of Foraminifera, that had been found by himself and Mr. Earland in the Selsey Shore-sands, but he had since heard it stated that the Fellows of the Society had been deceived on that occasion, because a number of the slides were not taken from Selsey specimens. In explanation of this he wished to say that rather than show pictures of damaged or inferior specimens from Selsey they had selected perfect examples of the same species from their own collections, and that the practice adopted on that occasion would be adopted in future.

The Chairman proposed that the thanks of the Society be given to Messrs. Gordon, Heron-Allen, Earland and others, who had contributed so much to the interest of their proceedings.

This, on being put to the Meeting, was carried unanimously.

The Chairman called attention to the exhibition of Pond Life which had been prepared that evening, and moved that the best thanks of the Society be given to those Fellows and to the Members of the Quekett Microscopical Club who had been to so much trouble to insure the success of the Exhibition.

This was also unanimously carried.

Notice was given, on behalf of the Council, that at the close of the business of the next Ordinary Meeting on June 16th a Special Meeting would be held for the purpose of receiving the Report of the Committee appointed on December 16th, 1908, and of dealing with the proposal to amend the By-laws of the Society.

Mr. J. W. Gordon reminded the Fellows that there would be a Meeting of the "Brass and Glass" Section on Wednesday, May 26th, when there would be a demonstration on the centring of the Microscope.

New Fellows :—The following were balloted for and duly elected *Ordinary* Fellows of the Society: Messrs. Arthur Cyrus Butterworth, Alexander D. Ferguson, Thomas S. Stewart, Francis Langridge Winton.

The following Instruments, Objects, etc., were exhibited :—

Mr. J. W. Ogilvy :—Blood from rat showing living Trypanosomes, under dark-ground illumination; Living typhoid bacilli, under dark-ground illumination.

Specimens of Pond-life as follow :—

Messrs. H. F. Angus and A. C. Banfield :—Some of the larger forms of Pond-life, such as *Hydrophilus piceus*, *Argyroneta aquatica*, etc., in small aquaria approximating to natural conditions, shown under Binocular Magnifiers × 4.
Mr. F. W. Watson Baker :—*Hydra tuba*, Ephyra; *Lophopus crystallinus.*
Mr. Jas. Burton :—*Arthrospira jenneri*, a rare alga, found in lake at Golder's Hill, Hampstead.
Mr. C. Campbell :—*Volvox* and an aquatic larva.
Mr. F. W. Chipps :—Young stage of *Plumatella repens.*
Mr. T. N. Cox :—*Nitella*, showing moment of protoplasm.
Mr. E. Cuzner :—*Fredericella sultana* from Quekett excursion, 1908; *Coleps hirtus*, *Bursaria*, etc.
Mr. D. Davies :—*Fredericella sultana*, *Melicerta ringens.*
Mr. A. Downs :—*Hydra viridis*; *Volvox globator.*
Mr. J. Drinkwater :—*Bursaria truncatella*; *Stephanoceros eichhorni.*
Mr. H. E. Freeman :—*Anguillula aceti* (vinegar eels).
Mr. Chas. E. Heath :—*Lophopus crystallinus.*
Mr. A. E. Hilton :—*Fredericella sultana.*
Mr. E. Hinton :—*Draparnaldia plumosa.*
Mr. A. M. Jones :—*Daphnia pulex.*
Mr. K. I. Marks :—Rotifera, various.
Mr. H. S. Martin :—*Daphnia pulex* (young female).
Mr. J. M. Offord :—*Hydra vulgaris.*
Mr. J. I. Pigg :—*Hydra viridis.*
Mr. F. J. W. Plaskitt :—*Meridion circulare.*
Mr. J. H. Pledge :—*Volvox globator*, showing irregularity of outline of cells and protoplasmic connections × 200.
Mr. D. J. Scourfield :—*Volvox aureus*, showing regularity of outline of cells and protoplasmic connections, also showing pigment spots in cells at anterior pole under $\frac{1}{12}$ in. oil-immersion objective.
Mr. C. J. H. Sidwell :—*Volvox globator*, showing constant current from anterior to posterior pole × 150.

Mr. T. H. Powell :—Cyclosis in *Vallisneria* with $\frac{1}{40}$-in. Apochromatic oil-immersion objective.
Mr. G. H. J. Rogers :—Desmids, various.
Mr. C. F. Rousselet :—Rotifers, various.
Mr. E. J. Saunders :—*Melicerta ringens.*
Mr. F. J. Smith :—*Stephanoceros eichhorni.*
Mr. C. D. Soar :—*Brachypoda versicolor* ♀.
Mr. H. Taverner :—*Diplodontus despiciens.*
Mr. G. Tilling :—*Fredericella sultana.*
Mr. W. Traviss :—*Spirillum rugula.*
Mr. W. T. Waller :—*Fredericella sultana* ; *Vorticella* sp.
Mr. J. C. Webb :—*Vorticellæ* and other infusoria.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

AUGUST, 1909

TRANSACTIONS OF THE SOCIETY.

XII.—*A New Illuminator for the Microscope.*

By J. W. Gordon, F.R.M.S.

(*Read May* 19, 1909.)

In bringing before the Society the speculum illuminator which is on the table this evening, I feel that I owe an apology to Dr. Spitta. A few months ago he requested me to supply him, for the purposes of the second edition of his book, with a drawing of my new apparatus. I did so, giving him a drawing which showed all the improvements at that time devised. Subsequent work with that form of the illuminator, however, has satisfied me that it was so very unhandy that I cannot now explain the still further improved form, which this evening I have the honour of submitting to the Society, without, at least by inference, criticising with some severity the design furnished to Dr. Spitta. In these circumstances I should, if I felt any responsibility for what has occurred, be thoroughly ashamed of myself; but, in fact, I did my best at the time, not being then aware how serious were the shortcomings of that model, and not having any idea of the newer improvements, which have, as I hope, made the model now submitted very much handier in use.

In principle the illuminator is the same—that is to say, it consists of a speculum having a ground-glass end turned towards the actual source of light. The importance of this ground-glass screen has been already pointed out to the Society. It enables us to make use of what is otherwise an impossible, though, when rendered possible, an extremely convenient, source of light—that is to say, the incandescent filament of an electric lamp. I have on previous occasions shown a glass speculum illuminated by means of a Nernst filament. If Nernst filaments could always be relied upon, nothing could be better; but, in fact, the Nernst filament works under such severe limitations that it can only be regarded as an article of luxury. The ordinary electric lamp is so very much more trustworthy, and, for that reason, so much more convenient, that an illuminator, to be successful for general use, must be designed for working with it. In the model now before the Society the form of lamp adopted is the tubular form. This enables one to place the ground glass end of the speculum within half an inch of the glowing filament. If these tubular lamps were made with still narrower tubes, so as to allow a yet closer approximation of the ground-glass to the incandescent filament, they would be even better for the purpose. In order to secure an arrangement by which the light may be placed as near as possible to the table, the lamp itself is arranged in a horizontal position, so that the lamp-socket stands to one side, and nothing, save the wall of the lamp-chamber, intervenes between the glass envelope and the bed of the lamp-stand.

With the same object of securing a low position on the table, the lamp support is mounted on a pillar of special construction. In theory this pillar is a girder made of three steel springs. In fact, however, owing to the circumstance that I made it myself, and under great pressure of time, its construction has been simplified, so that only the flange members of the girder are in use, the web member having been altogether omitted. The consequence is that this pillar is slightly flexible in one direction, and when the lamp is at its highest position it is liable to be easily shaken. That, however, is not a matter of very great consequence, because in its ordinary working position this mutilated girder is strong enough.

On the top of this pillar the lamp fitting is mounted in such a manner as to have a power of swinging through an angle of about fifteen degrees on either side of the horizontal position. A spring actuated brake-block bearing on the side of the pillar serves to give a holding grip which retains the fitting in any angular position in which it may be placed.

The lamp-chamber comprises an opaque screen surrounding the lamp and attached to the side wall of the chamber, which screen itself constitutes the top, bottom, back and front walls of the chamber. The sixth side is left open, for the purpose of ventilation, as the light which issues in that direction causes no inconvenience to the user of the Microscope. The side-wall is pierced by a circular opening into which a wooden plug fits. The face of this plug internal to the chamber carries the lamp socket. The reason for placing this socket on a circular plug, and not directly on the wall of the chamber, is that in that way we obtain the power of rotating the lamp about its own axis. An electric

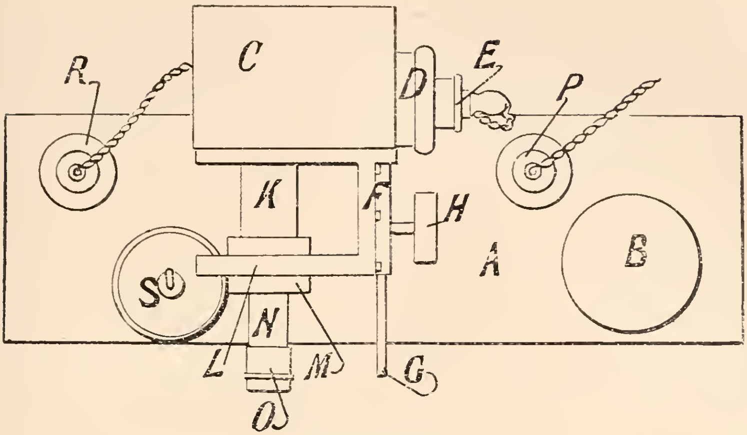


FIG. 71—PLAN.

A. Bed of the instrument.
B. Milled head for raising and depressing the lamp.
C. Lamp-chamber.
D. Circular plug for carrying the lamp-socket.
E. Lamp-socket.
F. Central support by which the lamp-chamber and speculum are carried.
G. Rack by which the lamp-chamber is moved backward and forward to vary the brightness of the light.
H. Milled head for enabling the observer to operate the rack.
K. Tube for screening the interior of the lamp-chamber from the view of the observer at the Microscope.
L. Plate carrying the speculum mount.
M. Speculum mount.
N. Tube carrying the mount for the bullseye.
O. Bullseye mount.
P. Plug for connecting up to electric circuit.
R. Plug for connecting lamp to electric supply.
S. Switch.

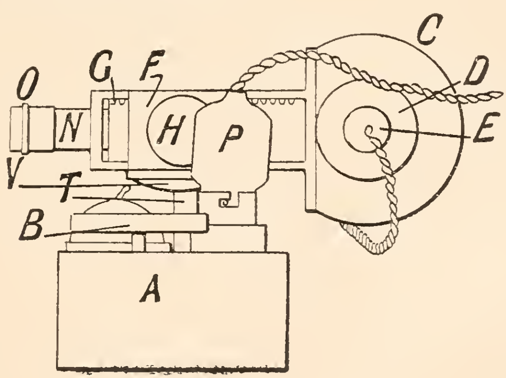


FIG. 72.—SIDE ELEVATION.

(The reference letters to Fig. 71 also indicate the same parts in this diagram.)

T. The collapsible pillar. V. The brake.

lamp does not, in fact, shed light equally in all directions. The convolutions of the filament by reason of their more or less shading one another, cause the light to be unequally distributed in various azimuths, and yield, moreover, unequal reflections in various directions. And then, again, the filament itself is never quite accurately centred in the lamp, and for these reasons it is desirable to be able to adjust the lamp by rotation about its own axis into that position in which it sheds the maximum amount of light upon the speculum.

The front wall of the lamp-chamber is pierced by a circular aperture to which a short tube is fitted. This tube is, for the sake of lightness, made of cardboard. It serves to prevent any light reflected from the interior of the lamp-chamber from reaching the eye of the observer at the Microscope. Through this tube and the aperture to which it is fitted the speculum extends backward in the direction of the lamp. At its fore end the speculum is mounted in a suitable fitting, so as to extend horizontally in front of the lamp. In order that the intensity of the light may be varied, the chamber containing the lamp is itself mounted upon a slide provided with a rack in which a pinion works. This slide is an extension of the side wall of the lamp-chamber, and is the sole support of the lamp-chamber and lamp. A milled head enables the operator to act through the pinion upon the rack, and by varying the distance between the ground-glass end of the speculum which is fixed and the lamp, which is thus made movable, to vary the strength of the light without varying its angle of incidence.

The speculum is mounted, as already stated, so as to be fixed in relation to the fitting. Substantially its mount consists of a tubular fitting in which the speculum itself is held, the tubular fitting being inserted into a flanged opening in a plate standing at right angles to the axis of collimation. This plate forms a rigid member of the central part of the fitting which is mounted, as already stated, so as to swing about the pillar for the purpose of collimating the speculum. An adjunct which can be fitted over the front of the speculum carries the bullseye and a cell for mounting stops and diaphragms when it is desired to modify the form of the light source. The bed of the instrument is so arranged that the milled head by which the lamp is raised or lowered stands well to one side, so as to be conveniently accessible to the operator's right hand. This little arrangement is, in fact, of capital importance. A lamp fitting which requires the operator to put his hand close to the lamp itself is for that reason alone impracticable. If his hand has to come into proximity with the lamp he must use his eye to guide it. In this instrument the handle, by which the lamp is raised or lowered, stands well clear, in a place by itself, where the observer can reach and operate it without fear of striking or disturbing anything else.

To summarise the advantages which this form of lamp presents:—

1. It has the capital advantage of the speculum, that is to say, the light-source is a circular, structureless disk, which can be made to give either as large or as small an illuminated field as is desired, and which, whatever the focusing of the condenser, never produces unsymmetrical diffraction and never exhibits any disturbing structure.

2. The intensity of the light is completely under the operator's control, and he can either increase or reduce it within very wide limits without producing any alteration in the angle under which the light falls upon his object. In practical working this is a matter of very considerable importance, because the observer can adjust the brightness to suit his eye without the penalty of altering the focal adjustment of his system. He is thus not bound to work with excessive light when working with critical illumination, and need not incur the fatigue resulting from that cause.

3. The adjustability of the lamp as to height enables the centring to be done with the utmost precision. It is astonishing with what precision a mirror can be angularly adjusted by hand for the purposes of positioning the source of light. It is less astonishing but much more annoying to observe how difficult it is to get a mirror to keep the position assigned to it. It is hardly possible, having gripped a mirror for the purpose of adjustment, to let it go without disturbing the adjustment made. For this reason it is immeasurably easier to make the fine-adjustment by means of a rising and falling lamp than by manipulating the mirror and, in fact, for really accurate centring, an appliance such as this lamp possesses is indispensable.

4. A merely mechanical convenience, but one which every mechanician will appreciate, is the absence of guides for controlling the movements of the lamp-chamber. The pillar, which is stiff enough to make guides of overhead construction superfluous, but which at the same time can rise and fall so effectually as to bring its burden right down into contact with the bed of the instrument, and can do this without going through the table on which it stands, is a mechanical novelty which will probably find useful application in other connections beside that to which it is here applied.

XIII.—*On the Recent and Fossil Foraminifera of the Shore-sands of Selsey Bill, Sussex.*—III.

By Edward Heron-Allen, F.L.S., F.R.M.S., and Arthur Earland.

(*Read May* 19, 1909.)

Plates XVII., XVIII.

Family VII. LAGENIDÆ.

Sub-family 1. **Lageninae.**

Lagena Walker and Boys.

92. *Lagena globosa* Montagu sp.

Vermiculum globosum Montagu, 1803, Test. Brit., p. 523.
Entosolenia globosa (Montagu) Williamson, 1858, Recent Foram. Gt. Britain, p. 8, pl. i. figs. 15, 16.
Lagena globosa (Montagu) Brady, 1884, Foram. 'Challenger,' p. 452, pl. lvi. figs. 1–3.
Ditto. (Montagu) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Walker and Jacob) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 77, pl. xiii. fig. 741.

Recent and fossil. The fossil specimens are principally derived from a clay, and exhibit great diversity in size. Some may possibly be primordial chambers of other Lagenidæ.

93. *Lagena lævis* Montagu sp.

Vermiculum læve Montagu, 1803, Test. Brit., p. 524.
Lagena vulgaris Williamson, 1858, Recent Foram. Gt. Britain, p. 4, pl. i. figs. 5, 5*a*.
Lagena lævis (Montagu) Brady, 1884, Foram. 'Challenger,' p. 455, pl. lvi. figs. 7–14, 30.
Ditto. (Montagu) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Montagu) Millett, 1901, Journ. R. Micr. Soc., p. 9.

Fossil (common) and recent (rare). The specimens, which are evidently from several sources, present great differences of appearance, some being practically globular, with a produced neck, others pyriform, ranging to attenuate. A few of the fossil specimens show spiral corrugations round the neck. The fossil specimens are all larger than the recent. Millett gives exhaustive references for this widely-distributed form in his Malay paper (*suprâ*).

94. *Lagena clavata* d'Orbigny sp.

Oolina clavata d'Orbigny, 1846, For. Foss. Vienne, p. 24, pl. i. figs. 2, 3.
Lagena lævis var. *amphora* Williamson, 1848, Ann. and Mag. Nat. Hist., ser. 2, vol. i. p. 12, pl. i. figs. 3, 4.
Lagena vulgaris var. *clavata* Williamson, 1858, Recent Foram. Gt. Britain, p. 5, pl. i. fig. 6.
Lagena clavata (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 75, pl. xiii. figs. 725–27.

Recent. Typical.

95. *Lagena striata* d'Orbigny sp.

Oolina striata d'Orbigny, 1839, Foram. Amér. Mérid., p. 21, pl. v. fig. 12.
Lagena substriata Williamson, 1848, Ann. and Mag. Nat. Hist., ser. 2, vol. i. p. 15, pl. ii. fig. 12.
Lagena vulgaris var. *substriata* Williamson, 1858, Recent Foram. Gt. Britain, p. 7, pl. i. fig. 14.
Lagena striata (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 460, pl. lvii. figs. 22, 24, 28, 29, etc.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 75, pl. xiii. figs. 732–6.

Recent and fossil. Rare.

96. *Lagena sulcata* Walker and Jacob sp.

Serpula (*Lagena*) *sulcata* Walker and Jacob, 1798, Adam's Essay, Kammacher's ed., p. 634, pl. xiv. fig. 5.
Lagena vulgaris var. *perlucida* (pars) Williamson, 1858, Recent Foram. Gt. Britain, p. 5, pl. i. fig. 8.
Lagena vulgaris var. *striata* Williamson, 1858, Recent Foram. Gt. Britain, p. 6, pl. i. fig. 10.
Lagena sulcata (Walker and Jacob) Brady, 1884, Foram. 'Challenger,' p. 462, p. lvii. figs. 23, 25, 26, 27, 33, 34; pl. lviii. figs. 4, 5, 6, 17, 18.
Ditto. (Walker and Jacob) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Walker and Boys) Goës, 1894, Arctic and Scandinavian Foram., p. 78, pl. xiii. fig. 744.

Fossil and recent. The fossil specimens are apparently from several sources. Recent specimens occur which may be referred to Williamson's var. *interrupta*, which is of doubtful varietal value.

97. *Lagena acuticosta* Reuss.

Lagena acuticosta Reuss, 1861, Sitz. k. Akad. Wiss. Wien, vol. xliv. p. 305, pl. i. fig. 4.
Ditto. (Reuss) Brady, 1884, Foram. 'Challenger,' p. 464, pl. lvii. figs. 31, 32; pl. lviii. figs. 20 (?), 21.

One small specimen, of a very elongate type, and with only five costæ—apparently a Cretaceous fossil.

98. *Lagena williamsoni* Alcock sp.

Entosolenia williamsoni Alcock, 1865, Proc. Lit. and Phil. Soc. Manchester, vol. iv. p. 195.
Lagena williamsoni (Alcock) Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. (Sci.) p. 339, pl. xiv. figs. 6–8.
Ditto. (Alcock) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil and recent. Fairly frequent, the recent specimens predominating.

99. *Lagena semistriata* Williamson.

Lagena striata var. *β semistriata* Williamson, 1848, Ann. and Mag. Nat. Hist., ser. 2, vol. i. p. 14, pl. i. figs. 9, 10.
Lagena vulgaris var. *semistriata* Williamson, 1858, Recent Foram. Gt. Britain, p. 6, pl. i. fig. 9.
Lagena semistriata (Williamson) Brady, 1884, Foram. 'Challenger,' p. 465, pl. lvii. figs. 14, 16, 17.
Ditto. (Williamson) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil and recent. The recent specimens agree in all respects with Williamson's type. The fossil specimens contain examples both of the type, and of Williamson's type *perlucida*.

100. *Lagena squamosa* Montagu sp.

Vermiculum squamosum Montagu, 1803, Test. Brit., p. 526, pl. xiv. fig. 2.
Entosolenia squamosa (Montagu) Williamson, 1858, Recent Foram. Gt. Britain, p. 12, pl. i. fig. 29.
Lagena squamosa (Montagu) Brady, 1884, Foram. 'Challenger,' p. 471, pl. lviii. figs. 28–31.
Ditto. (Montagu) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Montagu) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 79, pl. xiii. fig. 745.

Recent.

101. *Lagena reticulata* Macgillivray sp.

Lagenula reticulata Macgillivray, 1843, Hist. Test. Anim. Aberdeen, etc., p. 38.
Lagena reticulata (Macgillivray) Reuss, 1862, Sitz. k. Akad. Wiss. Wien, vol. xliv. p. 335, p. v. figs. 67, 68.
Ditto. (Macgillivray) Jones, 1895, Palæont. Soc., p. 195, pl. iv. fig. 7.

Fossil and recent. The fossil specimens are apparently derived from a clay.

102. *Lagena hexagona* Williamson sp.

Entosolenia squamosa var. *hexagona* Williamson, 1848, Ann. and Mag. Nat. Hist., ser. 2, vol. i. p. 20, pl. ii. fig. 23.
Ditto. Williamson, 1858, Recent Foram. Gt. Britain, p. 13, pl. i. fig. 31.
Entosolenia squamosa var. *scalariformis* Williamson, 1858, Recent Foram. Gt. Britain, p. 13, pl. i. fig. 30.
Lagena hexagona (Williamson) Brady, 1884, Foram. 'Challenger,' p. 472, pl. lviii. figs. 32, 33.
Ditto. (Williamson) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil. Rare.

103. *Lagena lævigata* Reuss sp.

Fissurina lævigata Reuss, 1849, Denkschr. d. k. Akad. Wiss. Wien, vol. i. p. 366, pl. xlvi. fig. 1.
Lagena lævigata (Reuss) Balkwill and Millett, 1884, Journ. Micr., vol. iii. p. 80, pl. ii. fig. 6; trigonal form, p. 81, pl. iii. fig. 6.
Ditto. (Reuss) Brady, 1884, Foram. 'Challenger,' p. 473, pl. cxiv. fig. 8 *a, b*.
Ditto. (Reuss) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil and recent.

104. *Lagena lucida* Williamson sp.

Entosolenia marginata var. *lucida* Williamson, 1858, Recent Foram. Gt. Britain, p. 10, pl. i. figs. 22, 23.
Lagena oblonga (Seguenza) J. Wright, 1876-7, Proc. Belfast Field Club (Appendix), p 104, pl. iv. fig. 9 *a, b*.
Lagena lucida (Williamson) Balkwill and Millett, 1884, Journ. Micr., vol. iii. p. 80, pl. ii. fig. 7, and pl. iii. figs. 4, 5.
Ditto. (Williamson) Brady, 1887, Synopsis British Recent Foraminifera.

Recent only.

105. *Lagena marginata* Walker and Boys.

Serpula (Lagena) marginata Walker and Boys, 1784, Test. Min., p. 2, pl. i. fig. 7.
Entosolenia marginata (pars) Williamson, 1858, Recent Foram. Gt. Britain, p. 10, pl. i. fig. 21.
Lagena marginata (Walker and Boys) Brady, 1884, Foram. 'Challenger,' p. 476, pl. lix. figs. 21-3.
Ditto. (Walker and Boys) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil and recent, the former predominating in numbers. The marginal keel is only slightly developed in the Selsey specimens, and the fossils come from two or three different sources.

106. *Lagena orbignyana* Seguenza sp.

Entosolenia marginata (pars) Williamson, 1858, Recent Foram. Gt. Britain, p. 10, pl. i. figs. 19, 20.
Fissurina orbignyana Seguenza, 1862, Foram. Monotal. Misc. Messina, p. 6, pl. ii. figs. 65, 66.
Lagena orbignyana (Seguenza) Brady, 1884, Foram. 'Challenger,' p. 484, pl. lix. figs. 1, 18, 24–6.
Ditto. (Seguenza) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil (frequent) and recent (rare). The recent specimens present no features different from those usually found in shore specimens, but the fossils, the majority of which are apparently derived from clays, vary greatly in size, convexity, and width of "wing." Some of the fossil specimens are covered with an adherent matrix; these may possibly be derived from the limestone of the Mixon Rocks.

107. *Lagena orbignyana* var. *selseyensis* var. n.

(Plate XVII. figs. 1, 2.)

Among the specimens referable to Seguenza's species *L. Orbignyana* are a number which possess sufficiently striking individuality to render them worthy of separate and particular notice, and for them we propose the varietal name "*selseyensis*." The specimens, which are all fossils, and apparently derived from the same source of origin—which, judging from their appearance, was probably a shell-sand of sub-tropical origin, such as characterises the fauna of many early Tertiary formations—are of a somewhat elongate form; the two faces of the shell are nearly parallel and surrounded by a raised edge, which is also extended into a "wing." The intermediate, or middle wing, which is of about the same diameter all round the shell, is strongly marked. The shell is

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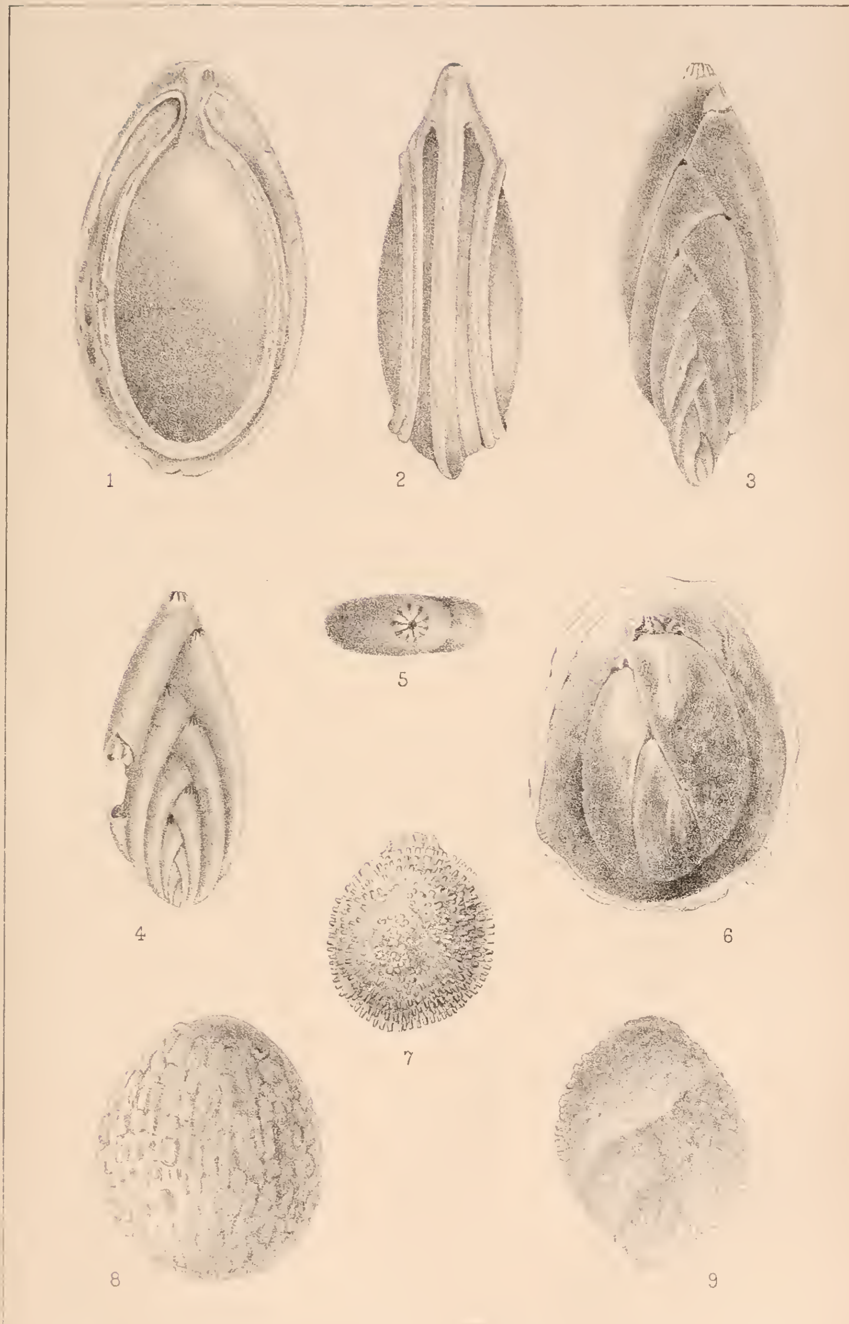
EXPLANATION OF PLATE XVII.

Fig. 1.—*Lagena orbignyana* Seguenza sp. var. *selseyensis*.
,, 2.—Ditto. Edge views.
,, 3.—*Polymorphina complanata* d'Orbigny.
,, 4.—Ditto.
,, 5.—Ditto. Oral aspect.
,, 6.—*P. concava* Will. Detached specimen.
,, 7.—*P. hirsuta* B. P. and J.
,, 8.—*P. ornata* Karrer.
,, 9.—*P. spinosa* d'Orb. sp.

Figs. 3, 4, 5 × 50 diam.; the others × 100 diam.



West, Newman lith

stout and massively built; the oral end is somewhat produced, the middle carina being continued to the very extremity. The surface is typically smooth in all instances.

Sub-family 2. **Nodosarinae.**

Nodosaria Lamarck.

108. *Nodosaria lævigata* d'Orbigny.

Nodosaria (Glandulina) lævigata d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 252, No. 1, pl. x. figs. 1–3.
Nodosaria lævigata (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 490, pl. lxi. figs. 20–2.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 71, pl. xiii. figs. 702, 703, 706, 707, 709.

Fossil only. Most of the specimens are of an elongate type, principally derived from clays.

109. *Nodosaria filiformis* d'Orbigny.

Nodosaria filiformis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 253, No. 14.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 500, pl. lxiii. figs. 3–5.

Fossil, apparently derived from both chalk and clay.

110. *Nodosaria soluta* Reuss.

Dentalina soluta Reuss, 1851, Zeitschr. deutsch. geol. Gesell., vol. iii. p. 63, pl. iii. fig. 4.
Nodosaria soluta (Reuss) Brady, 1884, Foram. 'Challenger,' p. 503, pl. lxii. figs. 13–16; var. pl. lxiv. fig. 28.
Ditto. (Reuss) Goës, 1894, Arctic and Scandinavian Foram., p. 70, pl. xii. fig. 690.

One fossil fragment, apparently referable to this species.

Frondicularia Defrance.

111. *Frondicularia inæqualis* Costa.

Frondicularia inæqualis Costa 1855, Mem. Accad. Sci. Napoli, vol. ii. p. 372, pl. iii. fig. 3.
Ditto. (Costa) Brady, 1884, Foram. 'Challenger,' p. 521, pl. lxvi. figs. 8–12.

Fossil. One imperfect specimen, from a clay. This species has been recorded from many fossil deposits of later Tertiary age.

Rhabdogonium Reuss.

112. *Rhabdogonium tricarinatum* d'Orbigny sp.

Vaginulina tricarinata d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 258, No. 4; Modèle No. 4.
Rhabdogonium pyramidale Karrer, 1861, Sitz. k. Akad. Wiss. Wien, vol. xvi. p. 19, pl. i. fig. 34.
Rhabdogonium tricarinatum (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 525, pl. lxvii. figs. 1–3.
Ditto. (d'Orbigny) Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. (Science) p. 344, pl. xii. figs. 17, 18.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

One specimen only, fossil and pyritised, from the Blue Band opposite West Street (Thorney Coastguard Station). It has been recorded from the Miocene of Baden (near Vienna) by Karrer, and from other later Tertiary deposits.

Cristellaria Lamarck.

113. *Cristellaria lata* Cornuel sp.

Marginulina lata Cornuel, 1848, Mém. Soc. Géol. France, sér. 2, vol. iii. p. 252, pl. i. figs. 34–7.
Planularia pauperata Jones and Parker, 1860, Quart. Journ. Geol. Soc., vol. xvi. p. 454, pl. xx. fig. 39.
Cristellaria lata (Cornuel) Brady, 1884, Foram. 'Challenger,' p. 539, pl. lxvii. fig. 18 *a*, *b*.

One fossil specimen; cretaceous.

114. *Cristellaria crepidula* Fichtel and Moll sp.

Nautilus crepidula Fichtel and Moll, 1803, Test. Micr., p. 107, pl. xix. figs. *g*–*i*.
Cristellaria crepidula (Fichtel and Moll) d'Orbigny, 1839, Foram. Cuba, p. 64, pl. viii. figs. 17, 18.
Cristellaria cymboides d'Orbigny, 1846, For. Foss. Vienne, p. 85, pl. iii. figs. 30, 31.
Cristellaria subarcuatula Williamson, 1858, Recent Foram. Gt. Britain, p. 29, pl. ii. 56, 57.
Cristellaria crepidula (Fichtel and Moll) Brady, 1884, Foram. 'Challenger,' p. 542, pl. lxvii. figs. 17, 19, 20; pl. lxviii. figs. 1, 2.
Ditto. (Fichtel and Moll) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Fichtel and Moll) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 62, pl. xi. figs. 599, 600.

Fossil. The specimens are of the megalospheric type.

115. *Cristellaria italica* Defrance sp.

Saracenaria italica Defrance, 1824, Dict. Sci. Nat., vol. xxxii. p. 177; ibid. 1827, vol. xlvii. p. 344; Atlas Conchol., pl. xiii. fig. 6.
Cristellaria (*Saracenaria*) *italica* (Defrance) d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 293, No. 26; Modèles 19 and 85.

Cristellaria subarcuatula var. *scapha* Williamson, 1858, Recent Foram. Gt. Britain, p. 30, pl. ii. figs. 60, 61.
Cristellaria italica (Defrance) Brady, 1884, Foram. 'Challenger,' p. 544, pl. lxviii. figs. 17, 18, 20–3.
Ditto. (Defrance) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil only. One good and typical specimen, of medium size.

116. *Cristellaria rotulata* Lamarck sp.

Lenticulites rotulata Lamarck, 1804, Ann. Mus., vol. v. p. 188, No. 3; and 1806, vol viii. pl. lxii. fig. 11.
Cristellaria rotulata (Lamarck) d'Orbigny, 1840, Mém. Soc. Géol. France, sér. 1, vol. iv. p. 26, pl. ii. figs. 16–18.
Cristellaria calcar (Linné) *typica* Williamson, 1858, Recent Foram. Gt. Britain, p. 27, pl. ii. figs. 52, 53.
Cristellaria rotulata (Lamarck) Brady, 1884, Foram 'Challenger,' p. 547, pl. lxix. fig. 13 *a*, *b*.
Ditto. (Lamarck) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Lamarck) Goës, 1894, Arctic and Scandinavian Foraminifera, p.60, pl. x. figs. 559–78.

Fossil and recent. All the specimens are small; the largest recent specimen is somewhat abnormal, and is characterised by a very large primordial chamber. The fossil specimens have the appearance of being derived from the London Clay.

117. *Cristellaria crassa* d'Orbigny.

Cristellaria crassa d'Orbigny, 1846, Foram. Foss. Vienne, p. 90, pl. iv. figs. 1–3.
Robulina deformis Reuss, 1851, Zeitschr. d. deutsch. geol. Gesell., vol. iii. p. 70, pl. iv. fig. 30.
Cristellaria crassa (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 549, pl. lxx. fig. 1 *a*, *b*.

One fossil specimen, apparently derived from the Chalk. The species, according to Brady, is very rare in the recent condition. It occurs more frequently in many later Tertiary deposits.

118. *Cristellaria nitida* d'Orbigny.

Cristellaria nitida d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 291, No. 5.
Cristellaria cassis (pars) (Fichtel and Moll) Parker, Jones, and Brady, 1871, Ann. and Mag. Nat. Hist., ser. iv. vol. viii. p. 244, pl. x. fig. 88.
Cristellaria nitida (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 549, pl. lxx. fig. 2 *a*, *b*.

Fossil. One specimen, from a clay. The carina is slightly serrate.

119. *Cristellaria cultrata* Montfort.

Robulus cultratus Montfort, 1808, Conchol. Systém., vol. i. p. 214, 54e genre.
Robulina cultrata (Montfort) d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 287, No. 1; Modèle No. 82.
Cristellaria cultrata (Montfort) Brady, 1884. Foram. 'Challenger,' p. 550, pl. lxx. figs. 4–8.

Fossil. The specimens are rare, and present both the megalospheric and microspheric forms. They are small, but well dedeveloped and typical.

Sub-family 3. Polymorphininae.

Polymorphina d'Orbigny.

120. *Polymorphina lactea* Walker and Jacob sp.

Serpula lactea Walker and Jacob, 1798, Adam's Essays (Kammacher's ed.) p. 634, pl. xiv. fig. 4.
Polymorphina lactea (typica) (pars) Williamson, 1858, Recent Foram. Gt. Britain, p. 70, pl. vi. fig. 147.
Polymorphina lactea var. *communis* Williamson, ibid. p. 72, pl. vi. figs. 153–5.
Polymorphina lactea (Walker and Jacob) Brady, Parker, and Jones, 1870, Trans. Linn. Soc. Lond., vol. xxvii. p. 213, pl. xxxix. figs. 1 *a–c*.
Ditto. (Walker and Jacob) Brady, 1884, Foram. 'Challenger,' p. 559, pl. lxxi. figs. 11, 14.
Ditto. (Walker and Jacob) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil and recent. Recent specimens frequent, fossil specimens abundant, characterised by the same diversity in (1) source of origin, (2) size, (3) shape or rotundity, as in the closely allied species *P. gibba*; indeed, with many of the specimens it is difficult to say to which form they should be referred. In such a collection of varying specimens it is possible to build up a series linking the two forms.

121. *Polymorphina oblonga* Williamson.

Polymorphina lactea var. *oblonga* Williamson, 1858, Recent Foram. Gt. Britain, p. 71, pl. vi. fig. 149.
Polymorphina oblonga (Williamson) Brady, Parker, and Jones, 1870, Trans. Linn. Soc. Lond., vol. xxvii. p. 222, pl. xxxix. fig. 7 *a, b*.
Polymorphina lactea var. *oblonga* (Williamson) Brady, 1887, Synopsis British Recent Foraminifera.
Polymorphina lactea var. *oblonga* (Williamson) Millett, 1903, Journ. R. Micr. Soc., p. 262, pl. v. fig. 5.

Recent and characteristic, but rare. The specific name, *P oblonga*, has been previously used by d'Orbigny for an elongate variety which has really no definite specific value, but presents characteristics allied to d'Orbigny's *P. problema* and *P. communis*. In view of the well-marked and constant features presented by the form which Williamson described as a variety of *P. lactea*, we are justified in suppressing d'Orbigny's species, and raising Williamson's variety to specific rank as *P. oblonga*, a definite type.

122. *Polymorphina concava* Williamson.

(Plate XVII fig. 6.)

Polymorphina lactea var. *concava*, Williamson, 1858, Rec. Foram. Gt. Britain, p. 72, pl. vi. figs. 151, 152.
Polymorphina concava (Williamson) Brady, Parker and Jones, 1870, Trans. Linn. Soc. Lond., vol. xxvii. p. 236, pl. xl. figs. 22 *a*, b.
Ditto. (Williamson) Brady, 1887, Synopsis British Recent Foraminifera.
Polymorphina lactea var. *concava* (Williamson) Sidebottom, 1907, Mem. Lit. and Phil. Soc. Manchester, vol. li. pt. 3, p. 14, pl. iii. figs. 8, 9.

One perfect, recent specimen, unattached. This pretty little Foraminifer is of very infrequent occurrence under any circumstances, and especially so in shore gatherings. Sidebottom (*suprà*) has written at some length upon the peculiar features of this species.

123. *Polymorphina gibba* d'Orbigny.

Polymorphina (*Globulina*) *gibba* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 266, No. 20; Modèle No. 63.
Polymorphina gibba (d'Orbigny) Brady, Parker, and Jones, 1870, Trans. Linn. Soc. Lond., vol. xxvii. p. 216, pl. xxxix. fig. 2 *a–d*.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 561, pl. lxxi. fig. 12 *a*, *b*.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil and recent. Very common, the fossil specimens especially abundant, and presenting the greatest possible variety of form, from the perfectly globular to compressed specimens hardly separable from *P. lactea*. The fossils are evidently derived from a number of different sources; many of them show signs of considerable wear and weathering. It will be observed later that this is one of the commonest Foraminifera in the Bracklesham clays of the artesian well boring, to be considered at a future date.

124. *Polymorphina sororia* Reuss.

Polymorphina (*Guttulina*) *sororia* Reuss, 1862, Bull. Acad. Roy. Belg., sér 2, vol. xv. p. 121, pl. ii. figs. 25–29.
Ditto. Reuss, 1870, Sitz. k. Akad. Wiss. Wien, vol. lxii. p. 487, No. 9; von Schlicht, 1870, Foram. Pietzpuhl, pl. xxvi. figs. 4–12, 16, 18.
Polymorphina sororia (Reuss) Brady, 1884, Foram. 'Challenger,' p. 562, pl. lxxi. figs. 15, 16.
Ditto. (Reuss) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil. This type is with difficulty separable from *P. lactea*, from which it is differentiated merely by its elongated sub-fusiform shape.

125. *Polymorphina angusta* Egger.

Polymorphina (*Globulina*) *angusta* Egger, 1857, Neues Jahrb. für Min., etc., p. 290, pl. xiii. figs. 13–15.
Polymorphina fusiformis (pars) Brady, Parker, and Jones, 1870, Trans. Linn. Soc. Lond., vol. xxvii. p. 219.
Polymorphina angusta (Egger) Brady, 1884, Foram. 'Challenger,' p. 563, pl. lxii. figs. 1–3.

One specimen, which is to all appearances a recent one. It may, however, be noted that this species is usually found in deep water only, and its occurrence in a shore-sand would therefore be a matter of some note. As a fossil it has been recorded from the Miocene.

126. *Polymorphina lanceolata* Reuss.

Polymorphina lanceolata Reuss, 1851, Zeitschr. d. deutsch. geol. Gesell., vol. iii. p. 83, pl. vi. fig. 50.
Polymorphina fusiformis (pars) (Roemer) Brady, Parker, and Jones, 1870, Trans. Linn. Soc. London, vol. xxvii. p. 219, pl. xxxix. fig. 5 *b, c*.
Polymorphina lanceolata (Reuss) Brady, 1884, Foram. 'Challenger,' p. 564, pl. lxxii. figs. 5, 6.
Ditto. (Reuss) Brady, 1887, Synopsis British Recent Foraminifera.

Frequent, and, with one possible exception, all fossil. The fossil specimens are evidently from several different sources, one, at least, being cretaceous. Of the others, some are apparently derived from clays, and others from sandy deposits.

127. *Polymorphina compressa* d'Orbigny.

Polymorphina compressa d'Orbigny, 1846, For. Foss. Vienne, p. 233, pl. xii. figs. 32–4.
Polymorphina lactea (Walker and Jacob) *typica* (pars) Williamson, 1858, Recent Foram. Gt. Britain, p. 70, pl. vi. figs. 145, 146.
Polymorphina compressa (d'Orbigny) Brady, Parker, and Jones, 1870, Trans. Linn. Soc. Lond., vol. xxvii. p. 227, pl. xl. figs. 12 *a–f*.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 565, pl. lxxii. figs. 9–11.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

Frequent and well developed. Fossil only, and apparently from several sources. A few specimens are evidently derived from the Mixon Rocks, as they are still imbedded in matrix.

128. *Polymorphina complanata* d'Orbigny.

(Plate XVII. figs. 3–5.)

Polymorphina complanata d'Orbigny, 1846, For. Foss. Vienne, p. 234, pl. xiii. figs. 25–30.
Ditto. (d'Orbigny) Jones, Parker, and Brady, 1866, Mon. Crag. Foram. (Palæont. Soc.), pl. i. figs. 52, 53, 60.

Polymorphina complanata (d'Orbigny) Brady, Parker, and Jones, 1870, Trans. Linn. Soc. Lond. vol. xxvii. p. 230, pl. xl. figs. 14 *a*, *b*, woodcuts *f–j*.
Ditto. (d'Orbigny) Balkwill and Millett, 1884, Journ. Micr. and Nat. Sci. vol. iii. p. 84, pl. iv. fig. 9.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

One large and perfect specimen, and several more or less imperfect. They are of an extremely compressed and elongate type, differing considerably in breadth from most of the figured specimens of *P. complanata.* Indeed, their general outline is strongly suggestive of *Frondicularia gaultina* (Reuss), but the true polymorphine nature of the shell is clearly marked by the fact that the earlier chambers are set in a somewhat different plane to the later ones. The specimens are undoubtedly fossil, and are probably derived from a clay, but it has been recorded among recent British Foraminifera by Balkwill and Millet (*suprà*) from the shore-sands of Galway. Their specimen, however, is of a broader and thicker build.

The large perfect specimen measures 1·15 mm. in length and 0·425 mm. in breadth; the smaller one, which is less attenuate, is 0·83 mm. in length and 0·375 in breadth.

129. *Polymorphina elegantissima* Parker and Jones.

Polymorphina elegantissima Parker and Jones, 1865, Phil. Trans., vol. clv. table x. p. 438.
Ditto. (Parker and Jones) Brady, Parker, and Jones, 1870, Trans. Linn. Soc. Lond., vol. xxvii. p. 231, pl. xl. figs. 15 *a–c*.
Ditto. (Parker and Jones) Brady, 1884, Foram. 'Challenger,' p. 566, pl. lxxii. figs. 12–15.

Fossil. The specimen, which is not very characteristic, is apparently derived from a clay. Brady's records are all from moderate depths in tropical and sub-tropical seas, but he mentions that the *P. problema* var. *deltoidea* of Reuss and *P. anceps* of Philippi are apparently inseparable from this species. These are both recorded as Tertiary fossils.

130. *Polymorphina communis* d'Orbigny.

Polymorphina (Guttulina) communis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 266, pl. xii. figs. 1–4; Modèle No. 62.
Polymorphina communis (d'Orbigny) Brady, Parker, and Jones, 1870, Trans. Linn. Soc. Lond., vol. xxvii. p. 224, pl. xxxix. fig. 10 *a*, *b*.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 568, pl. lxii. fig. 19.
Polymorphina problema (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

Frequent. The specimens are apparently all fossil.

131. *Polymorphina rotundata* Bornemann sp.

Guttulina rotundata Bornemann, 1855, Zeitschr. d. deutsch. geol. Gesell., vol. vii. p. 346, pl. xi., pl. xvii. fig. 3.
Polymorphina rotundata (Bornemann) Brady, Parker, and Jones, 1870, Trans. Linn. Soc. Lond., vol. xxvii. p. 234, pl. xl. figs. 19 *a–e* and woodcuts.
Ditto. (Bornemann) Brady, 1884, Foram. 'Challenger," p. 570, pl. lxxiii. figs. 5–8.
Ditto. (Bornemann) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil. Many and large, and one small recent specimen. The fossils are evidently derived from several different sources.

132. *Polymorphina myristiformis* Williamson.

Polymorphina myristiformis Williamson, 1858, Recent Foram. Gt. Britain, p. 73, pl. vi. figs. 156, 157.
Ditto. (Williamson) Brady, Parker, and Jones, 1870, Trans. Linn. Soc. Lond., vol. xxvii. p. 240, pl. xli. fig. 30 *a–c*.
Ditto. (Williamson) Brady, 1884, Foram. 'Challenger,' p. 571, pl. lxxiii. figs. 9, 10.
Ditto. (Williamson) Brady, 1887, Synopsis British Recent Foraminifera.

One good and typical specimen. Recent.

133. *Polymorphina ornata* Karrer.

(Plate XVII. fig. 8.)

Polymorphina ornata Karrer, 1868, Sitz. k. Akad. Wiss., vol. lvii. p. 175, pl. iv. fig. 10.
Ditto. (Karrer) Brady, Parker, and Jones, 1870, Trans. Linn. Soc. Lond., vol. xxvii. p. 242, pl. xli. figs. 34 *a*, *b*.

One fossil specimen, which agrees very well with the figure in Brady, Parker, and Jones's monograph (*suprà*), although the ornamentation is even more strongly pronounced. It is to all appearances derived from the Chalk. The locality of Karrer's specimens is not furnished, but they were presumably Miocene. As pointed out by Brady, Parker, and Jones (*suprà*) this form can hardly be separated from strongly-marked specimens of *P. myristiformis* (Williamson).

134. *Polymorphina tuberculata* d'Orbigny sp.

Globulina tuberculata d'Orbigny, 1846, For. Foss. Vienne, p. 230, pl. xiii. figs. 21, 22.
Polymorphina tuberculata (d'Orbigny) Brady, Parker, and Jones, 1870, Trans. Linn. Soc. Lond., vol. xxvii. p. 242, pl. xli. fig. 35 *a–d*.

Fossil. One specimen only. This form is with difficulty separable from the last named species; probably any considerable number of specimens would present a complete series of transitional types.

135. *Polymorphina regina* Brady, Parker, and Jones.

Polymorphina regina Brady, Parker, and Jones, 1870, Trans. Linn. Soc. Lond., vol. xxvii. p. 241, pl. xli. fig. 32 *a*, *b*.
Polymorphina semicostata Marsson, 1878, Mitth. Nat. Ver. Neu-Vorpommern u. Rugen, Jahrg., x. p. 150, pl. ii. fig. 19.
Polymorphina regina (Brady, Parker, and Jones) Brady, 1884, Foram. 'Challenger,' p. 571, pl. lxxiii. figs. 11–13.
Ditto. (Brady, Parker, and Jones) var. Wright, 1886, Proc. Belfast Nat. Field Club, 1884–5, App. ix. p. 331, pl. xxvii. figs. 13, 14.
Ditto. (Brady, Parker, and Jones) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 217.

Many specimens, all well defined; some fossil, others, to all appearances, recent. The distribution, with the exception of Earland's record from the Bognor shore-sands, is confined to tropical and sub-tropical shallow water. Fossil records are apparently confined to the Chalk, but our specimens are certainly not Cretaceous, being probably derived from Tertiary sands and clays.

136. *Polymorphina spinosa* d'Orbigny sp.

(Plate XVII. fig. 9.)

Globulina spinosa d'Orbigny, 1846, For. Foss. Vienne, p. 230, pl. xiii. figs. 23, 24.
Polymorphina spinosa (d'Orbigny) Brady, Parker, and Jones, 1870, Trans. Linn. Soc. Lond., vol. xxvii. p. 243, pl. xlii. figs. 36 *a*, *b*.
Ditto. (d'Orbigny) Siddall, 1878, Proc. Chester Soc. Nat. Sci., pt. ii. p. 48.
Ditto. (d'Orbigny) Balkwill and Wright, 1885, Trans. R. Irish Acad. (Science), vol. xxviii. p. 347, pl. xii. fig. 27.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

Many fossils, and one very fine specimen which is almost certainly recent. The fossils vary considerably in the abundance and size of the spines, and have the appearance of being derived from a Tertiary shell-sand. The species has been recorded in the recent state by Siddall from the estuary of the Dee, and by Balkwill and Wright from the Irish Sea (*suprà*). It has also been recently found by Earland in the Moray Firth.

137. *Polymorphina hirsuta* Brady, Parker, and Jones.

(Plate XVII. fig. 7.)

Polymorphina hirsuta Brady, Parker, and Jones, 1870, Trans. Linn. Soc. Lond., vol. xxvii. p. 243, pl. xlii. fig. 37.

One specimen, probably fossil, well marked and typical. The separation of this form from *P. spinosa* (d'Orbigny) is somewhat arbitrary, the only essential difference being in the character of the spines, which are fine and regular instead of being coarse or tubercular. *P. hirsuta* has been recorded as a fossil from the Crag, and also in the recent condition by Brady, Parker, and Jones from the West Indies.

Note.—Fistulose specimens referable to *P. lactea*, *P. gibba*, and *P. rotundata*, have also been observed in the Selsey shore-sands. Rupert Jones and Chapman have devoted much labour to the examination of the recorded specimens of fistulose *Polymorphinæ*, and the separation of these outgrowths into varieties (see Journ. Linn. Soc. (Zool.) vol. xxvi. 1897). But the question of giving varietal names to these abnormal outgrowths is very debatable. The different forms assumed by these abnormal growths, both free and attached, is, in our opinion (which is based upon a very extended series of recent specimens dredged in the North Sea) due entirely to the position assumed by the specimen at the time when it entered upon the proliferous stage of shell-growth, and the character and shape of the objects immediately surrounding it at that time, or to which it was adherent.

Uvigerina d'Orbigny.

138. *Uvigerina asperula* Czjzek var. *ampullacea* Brady.

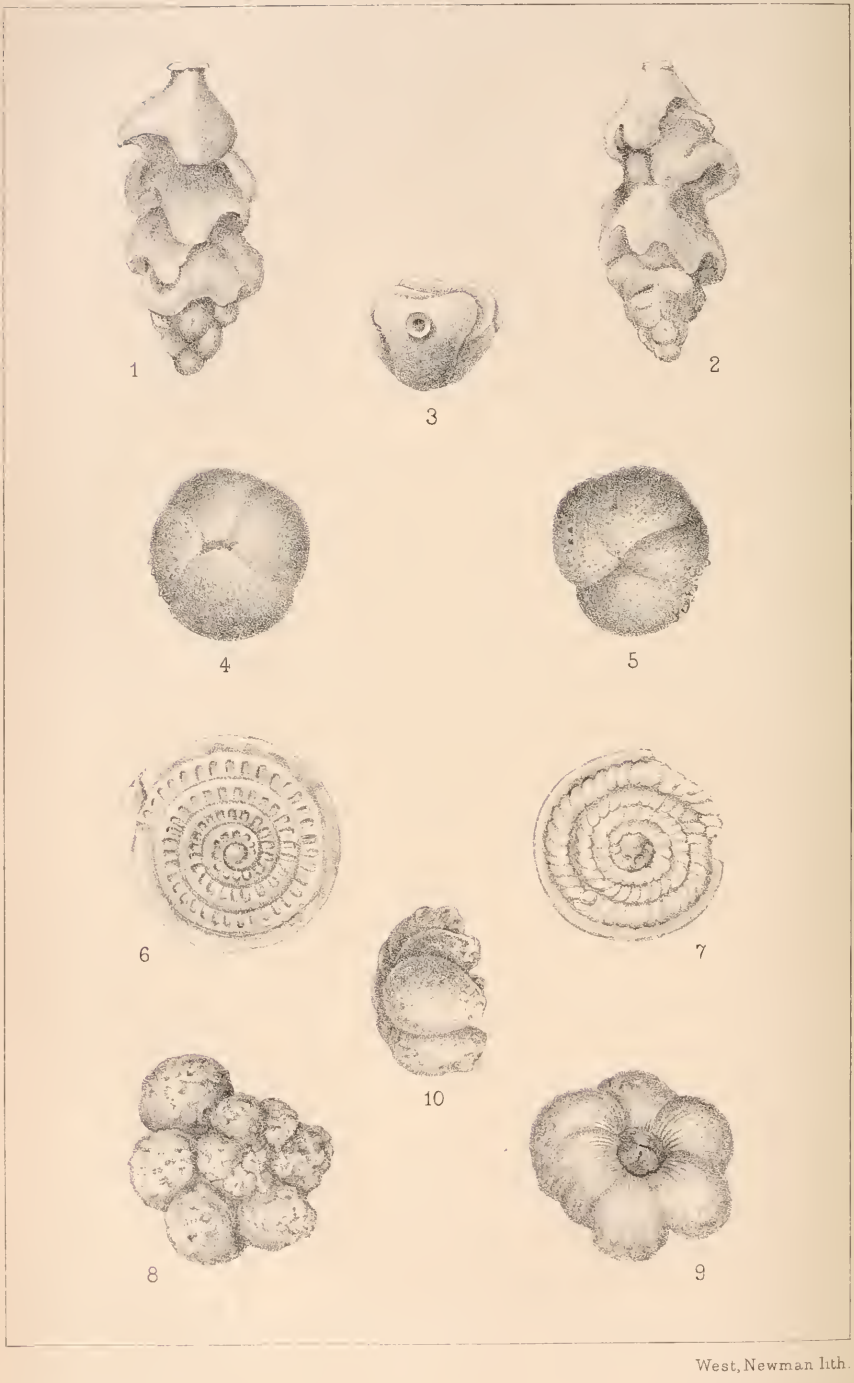
Uvigerina asperula var. *ampullacea* Brady, 1884, Foram. 'Challenger,' p. 579, pl. lxxv. figs. 10, 11.

One fossil specimen, pyritised, and probably from the London Clay. This variety has apparently not been previously recorded in the fossil state.

139. *Uvigerina angulosa* Williamson.

Uvigerina angulosa Williamson, 1858, Recent Foram. Gt. Britain, p. 67, pl. v., fig. 140.
Uvigerina pygmea var. *angulosa* (Williamson) Parker and Jones, 1865, Phil. Trans., vol. clv., p. 364, pl. xiii., fig. 68; pl. xvii., fig. 66.
Uvigerina angulosa (Williamson) Brady, 1884, Foram. 'Challenger,' p. 576, pl. lxxiv., fig. 15–18.
Ditto. (Williamson) Brady, 1887, Synopsis British Recent Foraminifera.

Rare, both in the recent and fossil states. As a recent shell it is widely distributed, but usually occurs in fairly deep water; as a fossil it has been recorded from the later Tertiary deposits.



West, Newman lith.

140. *Uvigerina muralis* Terquem.

Uvigerina muralis Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. 2, Mém. III. p. 119, pl. xii. figs. 26–9.

Fossil. We have found a good many specimens of this rather striking type, all of which are in agreement with the figures 27, 28, and 29 in Terquem's monograph. Terquem describes and figures two distinct forms under this name, one having a rough surface and with the earlier chambers arranged biserially, the other having a smooth surface and a consistently uvigerine arrangement. It appears probable, however, from the figure and description, that the rough surfaced specimens are a distinct form.

The specific name *muralis* very well describes the appearance of the form, the chambers of which look like rounded pebbles imbedded in a wall. Terquem's description also refers to this appearance of the shell, "formée des loges irregulières . . . agglutinées comme des petites pierres."

Terquem's specimens were from the Eocene of the Paris basin. He does not state whether they occur with frequency or otherwise.

141. *Uvigerina selseyensis* sp. n.

(Plate XVIII. figs. 1–3.)

Several fossil specimens. This handsome form presents appearances intermediate between *U. angulosa* (Williamson) and *U. porrecta* (Brady). It differs from *U. angulosa* in that the later chambers, which are triangular in shape, are set spirally around the central tube, as in *U. porrecta*, from which, however, it differs in the absence of the strongly marked costæ which characterise that species. The basal edge of each of the later chambers is strongly concave, whereas in *U. porrecta* the basal edge is convex. Length 0·4 mm., greatest breadth, 0·2 mm.

EXPLANATION OF PLATE XVIII.

Fig. 1.—*Uvigerina selseyensis* sp. n.
,, 2.—Ditto.
,, 3.—Ditto. Oral aspect.
,, 4.—*Globigerina pachyderma* Ehrenberg sp.
,, 5.—Ditto.
,, 6.—*Spirillina selseyensis* sp. n. Superior surface.
,, 7.—Ditto. Inferior surface.
,, 8.—*Discorbina cristata* sp. n. Superior surface.
,, 9.—Ditto. Inferior surface.
,, 10.—Ditto. Side views.

All figures × 100 diam.

Family VIII. GLOBIGERINIDÆ.

Globigerina d'Orbigny.

142. *Globigerina bulloides* d'Orbigny.

Globigerina bulloides d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 277, No. 1; Modèles Nos. 17 and 76.
Ditto. (d'Orbigny) Williamson, 1858, Recent Foram. Gt. Britain, p. 56, pl. v. figs. 116–118.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 593, pl. lxxvii., pl. lxxix. figs. 3–7.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

Very rare. The specimens are all fossil, and apparently derived from a clay, as well as from the Chalk.

143. *Globigerina cretacea* d'Orbigny.

Globigerina cretacea d'Orbigny, 1840, Mém. Soc. Géol. France, vol. iv. p. 34, pl. iii. figs. 12–14.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 596, pl. lxxxii. figs. 10, 11.

Frequent. All Chalk fossils.

144. *Globigerina linnæana* d'Orbigny sp.

Rosalina linnæana d'Orbigny, 1839, Foram. Cuba, p. 106, pl. v. figs. 10–12.
Rosalina canaliculata Reuss, 1854, Denkschr. d. k. Akad. Wiss. Wien, vol. vii. p. 70, pl. xxvi. fig. 4 *a*, *b*.
Globigerina linnæana (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 598, pl. lxxxii. fig. 12; pl. cxiv. fig. 21.

Frequent. From the Chalk.

145. *Globigerina dutertrei* d'Orbigny.

Globigerina dutertrei d'Orbigny, 1839, Foram. Cuba, p. 95, pl. iv. figs. 19–21.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 601, pl. lxxxi. figs. 1 *a–c*.

Fossil, pyritised, from the "Blue Band." A single specimen only.

146. *Globigerina pachyderma* Ehrenberg sp.

(Plate XVIII. figs. 4, 5.)

Aristerospira pachyderma Ehrenberg, 1873, Abhandl. d. k. Akad. Wiss. Berlin, (1872), p. 386, pl. i. fig. 4.
Aristerospira crassa, ibid., p. 388, pl. iii. fig. 9.
Globigerina omphalotetras, ibid., p. 388, pl. iii. fig. 11.

Globigerina bulloides (d'Orbigny), "arctic variety," Brady, 1878, Ann. and Mag. Nat. Hist., ser 5, vol. i. p. 435, pl. xxi. fig. 10.
Globigerina bulloides var. *borealis*, Brady, 1882, Proc. Roy. Soc. Edin., vol. xi. p. 716.
Globigerina pachyderma (Ehrenberg) Brady, 1884, Foram. 'Challenger,' p. 600, pl. cxiv. figs. 19, 20.

Rare, but quite typical fossils. As this is a distinctly Boreal species, it may be assumed that the specimens have been washed from the Glacial drift which underlies the Brick-earth and Alluvium of the peninsula. At the present time its distribution is confined to the Arctic seas and the cold areas of the Atlantic Ocean and North Sea, immediately to the southward of the Arctic Circle, such as the cold area of the Faroë Channel.

Family IX. ROTALIDÆ.

Sub-family 1. **Spirillininae.**

Spirillina Ehrenberg.

147. *Spirillina vivipara* Ehrenberg.

Spirillina vivipara Ehrenberg, 1841, Abhandl. k. Akad. Wiss. Berlin, p. 442, pl. iii., fig. 41.
Spirillina perforata Williamson, 1858, Recent Foram. Gt. Britain, p. 92, pl. vii. fig. 202.
Spirillina vivipara (Ehrenberg) Brady, 1884, Foram. 'Challenger,' p. 630, pl. lxxxv. figs. 1–5.
Ditto. (Ehrenberg) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Ehrenberg) Sidebottom, 1908, Mem. and Proc. Manchester Lit. and Phil. Soc., vol. lii. No. 13, p. 6, pl. i. figs. 12–14; pl. ii. figs. 1–3.

Recent, very rare; but frequent in the fossil state, and from various strata. One specimen at least is silicified and apparently from the Chalk.

148. *Spirillina inæqualis* Brady.

Spirillina inæqualis Brady, 1879, Quart. Journ. Micr. Sci., vol. xix. n.s., p. 278, pl. viii., fig. 25 *a*, *b*.
Ditto. (Brady) Brady, 1884, Foram. 'Challenger,' p. 631, pl. lxxxv., figs. 8–11.
Ditto. (Brady) Egger, 1893, Abhandl. k. Bayer. Akad. Wiss., Cl. II., vol. xviii., p. 394, pl. xviii., figs. 40–42.

One fossil specimen; typical and in good preservation. This species does not appear to have been hitherto recorded in the fossil state. Brady's specimens are from shallow water from various tropical localities. Under such conditions, the species has a fairly wide distribution. Our specimen is probably from one of the Tertiary strata which were laid down under similar climatic conditions.

149. *Spirillina limbata* Brady.

Spirillina limbata Brady, 1879, Quart. Journ. Micr. Sci., vol. xix. n.s., p. 278, pl. viii., fig. 26.
Ditto. (Brady) Brady, 1884, Foram. 'Challenger,' p. 632, pl. lxxxv. figs. 18–21.
Ditto. (Brady) Siddall, 1886, Proc. Lit. Phil. Soc., Liverpool, vol. xl., Appendix, p. 59.
Ditto. (Brady) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil. Several specimens, which are with some hesitation referred to this species, the matrix which is still adherent to them rendering their precise identification somewhat doubtful. One of the specimens is clearly derived from the limestone of the Mixon Rocks. It has apparently never been recorded previously in the fossil state.

150. *Spirillina margaritifera* Williamson.

Spirillina margaritifera Williamson, 1858, Recent Foram. Gt. Britain, p. 93, pl. vii. fig. 204.
Ditto. (Williamson) J. Wright, 1886, Proc. Belfast Nat. Field Club, App. 1885–86, p. 321, pl. xxvi. fig. 12.
Ditto. (Williamson) Brady, 1887, Synopsis British Recent Foraminifera.

Two fossil specimens from opposite Medmerry Farm (north-west corner). The locality of Williamson's specimen is not stated, and it is not clear whether it was a recent specimen or a derived fossil. The species is rare, but widely distributed in the recent state. It occurs in some abundance in coral sands from Macassar. Closely allied forms have been described by Terquem from the Eocene of Paris under the name of *S. nodifera*, and it is possible that our specimens are derived from a Tertiary deposit of similar age.

151. *Spirillina selseyensis* sp. n.

(Plate XVIII. figs. 6, 7.)

Several specimens of fossil origin have been found which are evidently closely allied to *S. margaritifera* Williamson, but which present well-marked points of distinction. The shell is somewhat concave on the superior side. The sutural lines are strongly limbate as in *S. margaritifera*, but the sutures are connected by shallower intermediate ridges. On the inferior side it is almost flat, though slightly excavated towards the umbilical region. Each whorl bears a series of raised tubercles which, increasing in size with the width of the spiral tube, are set at an angle to the periphery of the shell, so as to resemble the spiral twisting of the strands of a rope. Diameter, 0·25–0·3 mm.

Sub-family 2. **Rotalinae.**

Patellina Williamson.

152. *Patellina corrugata* Williamson.

Patellina corrugata Williamson, 1858, Recent Foram. Gt. Britain, p. 46, pl. iii. figs. 86–9.
Ditto. (Williamson) Brady, 1884, Foram. 'Challenger,' p. 634, pl. lxxxvi. figs. 1–7.
Ditto. (Williamson) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil and recent. The fossil specimen is of a very thin and scale-like type. The only hitherto recorded specimens are from Post-Tertiary beds of the north-west of Ireland and Scotland.

Discorbina Parker and Jones.

153. *Discorbina turbo* d'Orbigny sp.

Rotalia (*Trochulina*) *turbo* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 274, No. 29: Modèle No. 73.
Discorbina turbo (d'Orbigny) Parker, Jones, and Brady, 1865, Ann. and Mag. Nat. Hist., ser. 3, vol. xvi. p. 30, pl. ii. fig. 68.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 642, pl. lxxxvii. fig. 8.

Common in the fossil state, and a few specimens apparently recent. The fossils vary greatly in size, probably indicating different sources of origin.

154. *Discorbina globularis* d'Orbigny sp.

Rosalina globularis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 271, pl. xiii. figs. 1–4; Modèle No. 69.
Rotalina concamerata (Young) Williamson, 1858, Recent. Foram. Gt. Britain, p. 53, pl. iv. figs. 104, 105.
Discorbina globularis (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 643, pl. lxxxvi. figs. 8, 13.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Sidebottom, 1908, Mem. Manchester Lit. and Phil. Soc., vol. lii. No. 13, p. 11, pl. iii. figs. 3–8, and pl. iv. figs. 1, 2.

Rare in both recent and fossil conditions.

155. *Discorbina valvulata* d'Orbigny sp.

Rosalina valvulata d'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 271, No. 4.
Ditto. d'Orbigny, 1839, Foram. Cuba, p. 103, pl. iii. figs. 21–3.
Ditto. d'Orbigny, 1839, Foram. Canaries, p. 136, No. 28, pl. ii. figs. 19–21.
Discorbina valvulata (d'Orbigny) Jones and Parker, 1872, Quart. Jour. Geol. Soc., vol. xxviii. p. 114.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 644, pl. lxxxvii. figs. 5–7.

Fossil, apparently derived from a clay.

156. *Discorbina obtusa* d'Orbigny sp.

Rosalina obtusa d'Orbigny, 1846, Foram. Foss. Vienne, p. 179, pl. xi. figs. 4–6.
Discorbina turbo (d'Orbigny) var. *vesicularis*, subvar. *obtusa* Parker and Jones, 1865, Phil. Trans., vol. clv. p. 386, pl. xiv. figs. 18, 19.
Discorbina obtusa (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 644, pl. xci., fig. 9.
Ditto. (d'Orbigny) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 220, pl. xii. fig. 8, and pl. xiv. fig. 4.

Recent. The specimens resemble those figured by Earland from Bognor, and are of frequent occurrence.

157. *Discorbina rosacea* d'Orbigny sp.

Rotalia rosacea d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 273, No. 15; Modèle No. 39.
Rotalina mamilla Williamson, 1858, Recent Foram. Gt. Britain, p. 54, pl. iv. figs. 109–11.
Discorbina rosacea (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 644, pl. lxxxvii. figs. 1–4.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera..

Frequent, fossil and recent. The recent specimens are large and well developed.

158. *Discorbina vilardeboana* d'Orbigny sp.

Rosalina vilardeboana d'Orbigny, 1839, Foram. Amér. Mérid., p. 44, pl. vi. figs. 13-15.
Discorbina vilardeboana (d'Orbigny) Parker and Jones, 1872, Quart. Journ. Geol. Soc., vol. xxviii. p. 115.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 645, pl. lxxxvi. figs. 9–12; pl. lxxxviii. fig. 2.

Recent. One very fine specimen of this handsome variety.

159. *Discorbina isabelleana* d'Orbigny sp.

Rosalina isabelleana d'Orbigny, 1839, Foram. Amér. Merid., p. 43, pl. vi. figs. 10–12.
Discorbina isabelleana (d'Orbigny) Parker and Jones, 1872, Quart. Journ. Geol. Soc., vol. xxviii. p. 115.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 646, pl. lxxxviii. fig. 1.

We have a number of fossil specimens, probably Eocene, which are apparently referable to this type.

160. *Discorbina orbicularis* Terquem sp.

Rosalina orbicularis Terquem, 1876, Anim. sur la Plage de Dunkerque, p. 75, pl. ix. fig. 4 *a*, *b*.
Discorbina orbicularis (Terquem) Brady, 1884, Foram. 'Challenger,' p. 647, pl. lxxxviii. figs. 4–8.

Discorbina orbicularis. (Terquem) Balkwill and Wright, Trans. R. Irish Acad., vol. xxviii. (Science), p. 349, pl. xiii. figs. 31–3.
Ditto. (Terquem) Brady, 1887, Synopsis British Recent Foraminifera.

Common as fossils, and a few perhaps recent. The fossils vary greatly in size, and are evidently derived from various strata. It has been recorded from several Tertiary deposits.

161. *Discorbina parisiensis* d'Orbigny sp.

Rosalina parisiensis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii., p. 271, No. 1; Modèle No. 38.
Discorbina parisiensis (d'Orbigny) Parker, Jones, and Brady, 1865, Ann. and Mag. Nat. Hist., ser. 3, vol. xvi., pl. ii. fig. 70.
Ditto. (pars) (d'Orbigny) Wright, 1877, Proc. Belfast Nat. Field Club, 1876–7, Appendix, p. 105, pl. iv., fig. 1.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 648, pl. xc., figs. 5, 6, 9–12.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix., No. 57, p. 221, woodcut, pl. xii. figs. 4–7, and pl. xiv. fig. 5.

Recent. Specimens identical with those from Earland's collection at Bognor are fairly frequent. Plastogamic specimens have been observed, but less frequently than at Bognor.

162. *Discorbina wrightii* Brady.

Discorbina wrightii Brady, 1881, Denkschr. d. k. Akad. Wiss. Wien, vol. xliii. p. 104, pl. ii. fig. 6; Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 413, pl. xxi. fig. 6.
Ditto. (Brady) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Brady) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 223.

Recent. Less frequent than at Bognor.

163. *Discorbina opercularis* d'Orbigny sp.

Rosalina opercularis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 271, No. 7.
Ditto. d'Orbigny, 1839, Foram. Cuba, p. 101, pl. iii. figs. 24, 25, pl. iv. fig. 1.
Discorbina opercularis (d'Orbigny) Parker and Jones, 1872, Quart. Journ. Geol. Soc., vol. xxviii. p. 114.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 650, pl. lxxxix. figs. 8, 9.

Two specimens; fossil. It is a shallow-water tropical and sub-tropical form in the recent state.

164. *Discorbina rarescens* Brady.

Discorbina rarescens Brady, 1884, Foram. 'Challenger,' p. 651, pl. xc. figs. 2, 3, (4?).

Rare, but typical fossil specimens.

165. *Discorbina vesicularis* Lamarck sp.

Discorbites vesicularis Lamarck, 1804, Ann. du Muséum, vol. v. p. 183; vol. viii. pl. lxii. fig. 7.
Rotalia turbo var. *vesicularis* (Lamarck) Parker and Jones, 1860, Ann. and Mag. Nat. Hist., sèr. 3, vol. v. p. 293, No. 6.
Discorbina vesicularis (Lamarck) Brady, 1884, Foram. 'Challenger,' p. 651, pl. lxxxvii. fig. 2.
Ditto. (Lamarck) Earland, 1905, Journ. Quekett Micr. Cub., ser. 2, vol. ix., No. 57, p. 224, pl. xii. figs. 9, 10, and pl. xiv. fig. 6.

Fossil, frequent. All the specimens are of a large and well developed type such as are found in the recent state in Australian shore-sands. None of the thin-walled delicate specimens recorded by Halkyard from Jersey, and Earland from Bognor, have been found at present in the Selsey shore-sands.

166. *Discorbina dimidiata* Jones and Parker.

Discorbina dimidiata Jones and Parker, 1862, Carpenter, Parker, and Jones, Introduc. Foram., p. 201, fig. 32 *b*.
Ditto. (J. and P.) Parker and Jones, 1865, Phil. Trans., vol. clv., pp. 385, 422, pl. xix. figs. 9 *a–c*.
Ditto. (Jones and Parker) Chapman, 1907, Journ. Quekett Micr. Club, ser. 2, vol. x. No. 61, p. 136, pl. x. fig. 8.

Fossil only; frequent. This species, which differs from the type *D. vesicularis* (Lamarck), in the possession of a relatively flat inferior face, is abundant in the Australian shore-sands, in common with *D. vesicularis*, and its fossil records are probably identical. Lamarck's specimens of *D. vesicularis* were from the Eocene of the Paris basin. Our specimens are probably referable to the same period.

167. *Discorbina biconcava* Parker and Jones.

Discorbina biconcava Parker and Jones, 1865, Phil. Trans., vol. clv. p. 422, pl. xix. fig. 10 *a*, *b*, *c*.
Ditto. (Parker and Jones) Siddall, 1878, Proc. Chester Soc. Nat. Sci., pt. 2 p. 50.
Ditto. (Parker and Jones) Brady, 1884, Foram. 'Challenger,' p. 653, pl. xci. fig. 2 (*not* fig. 3).
Ditto. (Parker and Jones) Brady, 1887, Synopsis British Recent Foraminifera.

One specimen, fossil; in which condition the species does not appear to have been previously recorded.

168. *Discorbina saulcii* d'Orbigny sp.

Rosalina saulcii d'Orbigny, 1839, Foram. Amér. Mérid., p. 42, pl. ii. figs. 9–11.
Ditto. Parker and Jones, 1872, Quart. Journ. Geol. Sci., vol. xxviii. p. 156.

Fossil only. Its distribution in the recent state is confined to the shallow waters of sub-tropical seas.

169. *Discorbina trochidiformis* Lamarck sp.

Rotalites trochidiformis Lamarck, 1804, Ann. Mus., vol. v. p. 184; and 1806, vol. viii. No. 1, pl. lxii. fig. 8 *a*, *b*.
Discorbina trichidiformis (Lamarck) Jones, 1878, Dixon's Geology of Sussex, 2nd ed., p. 172, pl. ix. (10) fig. 6.
Rotalina trochidiformis (Lamarck) Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii. Mém. III. p. 68, pl. vi. fig. 2.

Fossil. Large specimens, apparently derived from the Mixon Rocks, are of frequent occurrence in the coarser gatherings.

Millett describes it as "common."

170. *Discorbina allomorphinoides* Reuss sp.

Valvulina allomorphinoides Reuss, 1860, Sitz. k. Akad. Wiss. Wien, vol. xl. p. 223, pl. xi. fig. 6.
Discorbina allomorphinoides (Reuss) Brady, 1884, Foram. 'Challenger,' p. 654, pl. xci. figs. 5, 8.
Ditto. (Reuss) Millett, 1903, Journ. R. Micr. Soc. p. 703.

Frequent; fossil. Reuss's specimens were from the Chalk, but these are apparently of a more recent, and probably Tertiary origin.

171. *Discorbina cristata* sp. n.

(Plate XVIII. figs. 8–10.)

We have found three specimens of fossil origin which we have been unable to identify with any published description within our knowledge, and we propose for them the specific name *D. cristata*.

Description.—Shell a rotaline spiral of about nine chambers arranged in two convolutions, the chambers rapidly increasing in size. The superior face but slightly convex and very rough in appearance, due to a thickening of the shell wall, which rises like a crest on each inflated chamber. The inferior face presenting only the five chambers of the last convolution, and opening in the centre into an umbilical cavity, which apparently extends to all the chambers of the test. The inferior side, which is covered with fine striæ radiating from the central umbilicus, is comparatively smooth, the depressions between the several chambers being very slight.

We cannot state whether the curious umbilical cavity is a normal feature of the shell, or merely due to a dissolution of the internal septa, such as has been described by Earland * as occurring in the reproductive stages of some recent *Discorbinæ* from the adjacent shore-sands of Bognor. A similar dissolution can be observed in many specimens of the genus *Polymorphina*, and has

* Earland, The Foraminifera of the Shore-sands of Bognor, 1905. Journ. Quekett Micr. Club, ser. 2, ix. No. 57, pp. 221–3.

been fully described by Sidebottom.* The inferior side of *D. cristata* is very similar to *D. pulvinata* Brady in the curious radiating striæ, but it differs from that form in the arrangement of the chambers and the appearance of the superior face. Sidebottom (*op. cit.*) refers to a variety of *D. pulvinata* which apparently approaches our species more closely than does the type.

Dimensions.—Greatest breadth, 0·225–0·3 mm.; least breadth, 0·2–0·225 mm. Height, 0·15 mm.

* Sidebottom, Foraminifera from the Island of Delos, 1907. Mem. and Proc. Manchester Lit. and Phil. Soc. li. No. 9, pp. 17–18.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Alleged Influence of Lecithin on Determination of Sex.‡—R. C. Punnett refers to Russo's experiments, as the result of which he claimed to have brought about a great increase in the relative number of female young produced by rabbits. Punnett prepared an emulsion by shaking up 5 grains of lecithin (Merck) with 100 c.cm. of physiological salt solution (0·65 p.c.). The daily dose for a rabbit was 20 c.cm. of this emulsion made up into a paste with meal, and the treatment was continued for three months before the doe was put to the buck, and for a few days thereafter. Ten does were treated in this way, and they eventually produced 47 young—24 male and 23 female. From these and other does not treated with lecithin Punnett had 18 litters with 103 young—54 male and 49 female. The numbers are not large in these experiments, but so far as they go they are entirely opposed to the view that feeding on lecithin has any influence on the relative proportion of the sexes among rabbits.

Parthenogenetic Segmentation in Birds.§—A. Lécaillon has observed in unfertilised eggs of the fowl a true parthenogenetic cleavage. The segmentation-cells multiply by mitosis, but the appearance is quite different from the normal. It affects only a part of the cicatricula, it proceeds more slowly than in fertilised eggs, and the cells degenerate one after another.

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Proc. Cambridge Phil. Soc., xv. (1909) pp. 92–3.

§ Comptes Rendus, cxlviii. (1909) pp. 52–3.

Structure and Function of Corpus Luteum.*—N. Niskoubina, working with the rabbit, finds that the glandular activity of the corpus luteum ceases abruptly towards the fifteenth day, that is, about the middle of the gestation. It has a preparatory action on the uterus during the first half of the gestation. Thereafter, and somewhat abruptly, the corpus luteum begins to show signs of a progressive atrophy.

Corpus Luteum and Mammary Gland.†—P. Ancel and P. Bouin find that there is a close correlation between the corpus luteum and the development of the mammary gland. The gland grows for 14 days, and then begins to retrogress; the corpus luteum develops for 14 days, and then begins to retrogress. It seems as if the corpus luteum conditioned the development of the gland.

In the course of gestation the mammary gland passes first through a "kinetic phase," characterised by numerous mitoses, which prepare all the cellular material of the future gland ; and, second, through a "glandular phase," characterised essentially by cytological changes, which transform the epithelial elements into glandular elements. It is the first of these two periods that is determined by the internal secretion of the corpus luteum.

Two Ova together in Rabbit.‡—Cl. Regaud and G. Dubreuil report finding two cases where two ova were contained within a common envelope of albumen. One of the pairs was in the uterus, the other in the oviduct. Follicles with two ova are well known, but what the authors describe is different. Each ovum has its proper envelope, and then both are wrapped up together.

Interstitial Cells of Testis in Frog.§—Christian Champy has studied these cells in *Rana esculenta*. They undergo a measure of involution in July, when the spermatogenesis is at its maximum. The nutritive substances formed go to sustain previously formed spermatozoa. There is probably some internal secretion, as the perivascular disposition of the interstitial cells suggests.

Interstitial Gland in Ovary of Rabbit.‖—G. Dubreuil and Cl. Regaud describe two extreme types of interstitial gland, macroscopically distinguishable. There is a slightly developed gland, which is very transparent, owing to the abundance of lipoid bodies in the young cells. There is a greatly developed gland, the opacity and milky whiteness of which are due to the abundance of fat in the adult cells. Many intermediate stages occur.

Interstitial Cells of Mole's Testis.¶—A. Lécaillon finds that these elements are very abundant in the non-active testis. They are not of uniform structure, and they do not differ essentially from interstitial cells in ovaries or in active testes. Some of the cells degenerate and

* C.R. Soc. Biol. Paris, lxvi. (1909) pp. 767–71.
† Tom. cit., pp 605–7.
‡ Comptes Rendus, cxlviii. (1909) pp. 1279–81 (1 fig.).
§ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 895–6.
‖ Tom. cit., pp. 901–3. ¶ Op. cit. lxvi. (1909) pp. 599–601.

disappear, which in part explains the reduction in the volume of the testis. Most of them seem inactive, but some have a differentiated cytoplasm with a compact zone and a reticulate zone, a structure which characterises active elements.

Hybrid Newts.*—W. Wolterstorff discusses the significance of the hybrids between *Triton cristatus* Laur. and *Triton vulgaris* L., and his conclusion is that the hybrids, which Poll has also studied very carefully, represent a primitive type of the sub-genus *Triton sensu stricto.* In *Triton alpestris*, *T. italicus*, and *T. marmoratus*, we have to do with more or less stable species, but *T. vulgaris* and *T. cristatus* are heterogeneous and variable groups.

Chondriosomes as Bearers of Inheritance.†—Fr. Meves calls attention to the "Nebenkern" in the spermatids, which v. la Valette St. George showed to be composed of cytomicrosomes present in the spermatocytes. These granules have had much study devoted to them under the name of "mitochrondria;" they occur not only in the spermatogenetic cells, but in differentiated somatic cells. Certain rodlets or threads, composed of mitochondrial substance, having been studied by Meves under the name of "chondriokonts," he now unites these with mitochondria under the title "chondriosomes," and seeks by studies in the early development of chick embryos to show that they may be justly regarded as cytoplasmic bearers of heritable qualities.

Notochord and Archenteron.‡—D. D. Ussoff has studied the development of the grass snake (*Tropidonotus natrix*), with particular reference to the notochord. His three main conclusions are:—(1) the notochord of Amniota, except at its anterior extremity, corresponds to a modified coalesced archenteron in *Amphioxus*; (2) the sclerotomes of Amniota correspond to degenerated primitive segments in *Amphioxus*; and (3) the nervous system of Amniota increases the number of its cells at the expense of the urochorda.

Notochord Cartilage in Urodela.§—Fr. Krauss has studied this in axolotl, newt, and salamander. The notochord-cartilage arises from chorda-epithelium cells and from vacuolated chorda cells. The share that these two kinds of cells take is described. Although the notochord arises from endodermic epithelium, it should be referred to the chondroid tissues, which include the vesicular supporting tissue in the tendon of Achilles of the frog and, in various cartilages of hag and lamprey. The notochord may be described as larval cartilage.

Colours of Highland Cattle.‖—James Wilson comes to the following conclusions:—(1) There are four colours forming the basis of present-day Highland colours, viz., black, blackish-brown or "donn," red, and light dun. One other colour, white, and other "markings"

* Zool. Anzeig., xxxiii. (1909) pp. 850–7.
† Arch. Mikr. Anat., lxxii. (1908) pp. 816–67 (4 pls.).
‡ Anat. Anzeig., xxxii. (1908) pp. 265–70 (5 figs.).
§ Arch. Mikr. Anat., lxxiii. (1908) pp. 69–116 (3 pls.).
‖ Sci. Proc. R. Dublin Soc., xii. (1909) pp. 66–76 (1 pl.).

have been absorbed from time to time, but these have been almost entirely bred out. The reds may be of several shades, but there are not sufficient data to separate them. (2) Black is the dominant of red. (3) Black produces dun hybrids—registered "dun," "dark dun," etc., when mated with light dun. (4) Donn or blackish-brown produces brindle hybrids when mated with black, red, and light dun. (5) Red produces yellow hybrids when mated with light dun.

b. Histology.

Thymus of Teleosteans.*—J. Aug. Hammar gives an account of the fully developed thymus in a large number of Teleosteans. He emphasizes the epithelial origin and nature of the thymus reticulum. The organ is an integral part of the epithelium of the branchial cavity. He does not find evidence of the autochthonous origin of the thymus lymphocytes. There is a migration of lymphocytes from outside during the period of differentiation. Myoid cells sometimes appear in the placode-like thymus before there is any appearance of vessels or connective tissue: these are not inclusions from without; they are autochthonous. As in higher animals, there is an age-involution of the thymus in Teleosteans; the involution is probably associated with reproductive maturity. Starving brings about accidental involution of the thymus.

Structure of Red Blood Corpuscles.†—A. Lelièvre and E. Retterer describe those of frog, larval salamander, larval *Alytes*, and embryo guinea-pigs and rabbits. From the surface of the nucleus there are radiating trabeculæ passing to the periphery. Still more delicate transverse threads unite these and form a reticulum. The meshes are closer towards the periphery. The early red blood corpuscles of Mammals are like those of other Vertebrates.

Shape of Mammalian Red Blood Corpuscles.‡—H. E. Jordan believes that the biconcave disk is the normal shape, and that all other shapes are simply variations or modifications of this. It is certainly very much easier to conceive of a biconcave flexible disk changing into a cup than the latter changing into such a regular disk as is characteristic of rouleaux. As a result of his examination of the omentum of the cat under ether, hanging-drop preparations of human blood, and sections of tissue from several domestic Mammals, he confirms the conclusion of Weidenreich and Lewis that mammalian blood contains "bell-shaped" or "cup-shaped" red corpuscles; but he is compelled to take issue with them in their opinion, that this represents the normal form, and that the biconcave disks are artefacts. His observations lead him to interpret all variations in normal blood from biconcave disk-shapes as the result of the operation of extrinsic physical factors, necessitating adjustment to narrow confines, or obstacles, or currents, or as the result of contact with viscid bodies (other corpuscles), and of unequal contraction.

* Arch. Mikr. Anat., lxxiii. (1908) pp. 1–68 (3 pls. and 10 figs.).
† C.R. Soc. Biol. Paris, lxvi. (1909) pp. 17–18.
‡ Anat. Anzeig, xxxiv. (1909) pp. 406–12.

Form and Size of Red Blood Corpuscles in Domestic Animals.* Ed. Retterer finds that the red blood corpuscles of ox, sheep, goat, pig, and horse are solid. Most are spherical, others hemispherical and lenticular. The following are the usual dimensions :—goat 2 μ, sheep 2·5–3 μ, ox 3–4 μ, pig and horse 3–4 μ, cat 3–4 μ, dog 4–5 μ, guinea-pig 3–5 μ. In man the spherical forms have a diameter of 5 μ, the hemispherical forms are 5–6 μ by 3 μ, the lenticular forms are 8–9 μ by 2 μ.

Degenerative Changes in Intestine of Tadpoles.†—E. Reichenow has studied the changes during metamorphosis. Among other results we note the following. As long as cell-multiplication continues—before and after the degeneration of the intestine—there are abundant mitoses in all the intestinal tissues. When no mitosis is to be found—during the shortening of the gut—there is no cell-multiplication. There is no amitosis in the intestine of the frog.

Skeletal Muscle of Vertebrates.‡—A. Lelièvre and E. Retterer find that the skeletal muscle-fibres in Amphibians and Mammals consist of—(1) an elastic envelope or sarcolemma ; (2) nuclei surrounded by a delicate zone of clear protoplasm ; (3) a differentiated mass with a definite network and an amorphous hyaloplasm. The network consists of trabeculæ and ramusculi, chromophilous in the young, elastic in the adult fibre. The hyaloplasm forms the greater part of the inter-trabecular strands ("bandelettes"), and constitutes the contractile element.

c. General.

Kern-plasma Relation Theory.§—W. T. Howard gives an account of the views of R. Hertwig and others on the relation between nuclear mass and cell mass, and he also discusses Schaudinn's doctrine of nuclear duality (the separation of nuclear material into germinative and somatic nuclear substance), and Goldschmidt's doctrine of the chromidial apparatus.

"The essence of the 'Kern-plasma relation theory' is that for each cell there is a definite size relation between nucleus (nuclear material) and protoplasm which may not be upset beyond certain physiological limits without serious consequences ; and that in each cell there is not only a normal mass relation between nuclear material and protoplasm, but the protoplasm possesses powers to preserve a normal equilibrium between the two. A cell is normal only so long as this balance is preserved within proper limits. In growing cells the balance is struck by growth of protoplasm ; in older cells, by the casting out of nuclear material into the protoplasm—chromidiosis—where it is destroyed and thrown off, and by dissolution and degeneration of nuclei. The chief causes of the upset of the Kern-plasma relation are increased function, starvation, change of temperature, fertilisation (in egg-cells), and the group of other conditions which lead to division. In these states the nucleus takes up an increased amount of material from the protoplasm."

* C.R. Soc. Biol. Paris, lxv. (1908) pp. 594–6.
† Arch. Mikr. Anat., lxxii. (1908) pp. 671–718 (1 pl. and 5 figs.).
‡ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 602–6.
§ Johns Hopkins Hospital Bulletin, xix. (1908) pp. 161–8.

Study of Autotomy.*—H. Piéron discusses a number of cases. The autotomy of the elytra of *Acholöe astericola*, which lives in the ambulacral grooves of starfishes, is quite independent of the phosphorescence. There is not usually much autotomy in Blattidæ, but it is marked in *Blatta* (*Ectobia*) *livida* as regards all the limbs. The influence of the position of the exciting stimulus on the autotomy is discussed, and several other problems are raised.

Dwarf Faunas.†—H. W. Shimer discusses the chief agencies in dwarfing aquatic Invertebrates. He finds evidence of dwarfing as the result of (1) a chemical change in the water (freshening, concentration, increase of H_2S, etc.); (2) the presence of mud and other mechanical impurities in the water; (3) attachment to floating seaweed; (4) great changes in temperature; and (5) great changes in depth. A few examples of dwarfed fossils are given, with a brief discussion of the probable cause of the dwarfing in each case.

Some abnormality in habitat causes an unusual expenditure of vitality in the continuance of life. There is less energy to spare for growth. Dwarfing would result in forms with comparatively little vitality. Some faunas are composed of relatively small species; others of small representatives of species which are larger elsewhere. Dwarfing shows itself in an acquirement of old age characters by the dwarfed animal or by a retention of juvenile characters.

Rat without a Tail.‡—Corsy reports the occurrence of a female rat (*Mus rattus*) without any trace of a tail. There was no hint of scar. The sacrum was normal, and behind that there was a coccygeal rudiment suggestive of arrest of development. The defect is regarded as congenital.

Variations in Vertebral Column of Echidna.§—G. P. Frets has studied a number of skeletons and finds considerable variability. He distinguishes ontogenetic change that seems to spread from behind towards the head, and another which works in the opposite direction. The former is more common and leads to more frequent variations.

Asymmetry of Skull in Toothed Whales.‖—W. Kükenthal seeks in an ingenious essay to correlate the peculiar shape and movements of the tail-flukes with the asymmetry of the anterior part of the skull. We cannot give his arguments, but the conclusion is that the asymmetry is an adaptation to unequal water-pressure on the front of the head, and this is due to the way the flukes work.

Early History of Irish Horse.¶—R. F. Scharff argues that the Irish domesticated Crannog horse is the direct descendant of the apparently wild Shandon horse, and that primitive man domesticated the wild horses which he found in Ireland. He inquires whether the Arab, or, as Prof.

* C.R. Soc. Biol. Paris, lxvi. (1909) pp. 172–4.
† Amer. Nat., xlii. (1908) pp. 472–90.
‡ C.R. Soc. Biol. Paris, lxiv. (1908) p. 987.
§ Morphol. Jahrb., xxxviii. (1908) pp. 608–53 (14 figs.).
‖ Anat. Anzeig., xxiii. (1908) pp. 609–18 (3 figs.).
¶ Proc. R. Irish Acad., xxvii. Section B, No. 6 (1909) pp. 81–6.

Ridgeway would call them, Libyan features in the Irish horse are the result of introductions by mankind of eastern or Spanish blood, or whether those features were inherited from a wild ancestor. He believes that the latter was the case, but further inquiry is necessary.

Osmotic Pressures of Blood and Eggs of Birds.*—W. R. Gelston Atkins points out that this subject has received very little attention, though it may have much interest in connection with development. He has studied the blood of fowl, turkey, duck, goose and rhea, and the eggs of fowl and duck. The method adopted was the determination of the freezing points. He finds that the blood and eggs of birds are not isotonic, the osmotic pressure of the egg being considerably the lower. The blood of each kind of bird has an almost constant freezing-point, the fluctuations being of the same order as those met with in Mammals. The difference in the osmotic pressures of the blood and egg is rather more than accounted for by the diminution in the inorganic salts of the egg as compared with the blood.

Three New Bird Records for Britain.†—R. M. Barrington records Pallas's grasshopper warbler (*Locustella certhiola* Pall.) picked up at Rockabill Light-house. The only other European record is Gätke's in Heligoland. He also records, as new for Ireland, the little bunting (*Emberiza pusilla* Pall.) and the reed-warbler (*Acrocephalus streperus* Vieillot).

Behaviour of Newly-hatched Loggerhead Turtles.‡—Davenport Hooker finds that newly-hatched loggerhead turtles move away from transparent and opaque red, orange, and green, and from green bay-cedar bushes, and move towards transparent or opaque blue. This has probably to do with their reaching the sea. After entering the water they swim out to sea, apparently attracted by the darker blue of the deeper water. In a large sand-pit from which bushes and ocean were invisible, they showed no tendency to move in a definite direction. In a restricted environment, the young turtle is not only "chromotropic" but positively phototropic. Their behaviour is not affected by the sound or odour of the sea.

Brain of Proteus anguineus.§—O. Hirsch-Tabor finds that the brain of *Proteus* remains at a somewhat low level. The bulbus oculi is markedly atrophied at the stage of the secondary optic cup. There is a distinct intrabulbar optic nerve, but only a short epibulbar stump of an extrabulbar nerve. There is no optic chiasma, or trace of intra-cerebral optic fibres, or layers in the grey matter of the tectum opticum. The mid-brain roof is narrow.

Differentiated eye-muscles were not distinguishable, nor any corresponding nerves; Kohl saw six eye-muscles, which probably shows the variability of these degenerate structures. The sensory bulbus nerves

* Sci. Proc. R. Dublin Soc., xii. (1909) pp. 123–30.
† Tom. cit., pp. 18–20.
‡ Ann. Rep. Carnegie Inst., Washington, vii. (1908) p. 124.
§ Arch. Mikr. Anat., lxxii. (1908) pp. 719–30 (3 figs.).

are very large; the fibres passing from their nuclei to the tectum are strongly developed. The commissura ansulata and decussatio transversa seem stronger than in other Amphibia. There is no cerebellum. A unique bundle extends over the middle line at the caudal end of the roof of the mesencephalon, probably representing a crossing of the cerebellar nerve-tracts isolated by the absence of the cerebellum.

The degeneracy of the optic apparatus is associated with the cave life; the strong development of other sensory tracts is a compensatory hypertrophy; the absence of cerebellum is associated with the sluggish mode of life.

Sailing Fishes.*—Louis Dollo discusses what Brousonnet called "poissons voilier," that is to say fishes that use the dorsal fin as a sail. This is said to be true of *Histiophorus*. Dollo argues that it is also true of *Playyodus*, which is not abyssal, as is generally supposed, but pelagic. It is probable that *Cetorhinus* and *Orthagoriscus* are in the same position. It is possible, Dollo thinks, that *Orca* and *Globicephalus* are "sailing" Cetaceans, just as *Velella* and *Physalia* are "sailing" Siphonophora.

Story of Devil-Fish.†—Theodore Gill contributes one of his interesting studies on fishes, his subject being what are called devil-fishes. The name has been widely used, but the author restricts it to a family of ray-like Selachians, variously known as Cephalopteridæ, Pterocephalidæ, Mobulidæ, and Mantidæ. They are the largest and widest of rays, and have horn-like extensions on each side of the head. They inhabit warm seas and feed chiefly on small crustaceans and young or small fishes. Normally there is a single young one at a birth.

Removal of Swim-bladder in Minnow.‡—J. Giaja removed the swim-bladder from a number of specimens of *Phoxinus lævis*, and found that disturbances resulted somewhat like those observed by Gouriet and Bonnier in the carp. The minnows moved as if with more effort than usual, rose often to the surface, and kept the body curved with the caudal part hanging down. But they did not lose their balance as the carp did. At the end of six months two which had been operated on were indistinguishable from their uninjured neighbours, but there was no regeneration.

Fishes of Illinois.§—S. A. Forbes and R. E. Richardson have in a handsome and beautifully illustrated volume furnished a reliable guide to a knowledge of the fishes of Illinois. This includes an account of their local and general distribution, and of their relations to their environment. The authors give careful descriptions of 150 species based on personal observation, and they discuss the habits and utilities of the fishes and their importance in the general system of aquatic life.

* Zool. Jahrb., xxvii. (1909) pp. 419–38 (2 figs.).
† Smithsonian Misc. Collections, lii. (1909) pp. 155–80 (16 figs.).
‡ C.R. Soc. Biol. Paris, lxv. (1908) pp. 125–6.
§ The Fishes of Illinois: Natural History Survey of Illinois. Published by authority of the State Legislature, 1908, cxxxi. and 357 pp.; numerous col. pls., with an atlas of 103 maps showing the distribution.

Parasites in Roumania.*—N. Leon gives a list of the animal parasites which he has to deal with in his laboratory at Iassy. He notes *Entamœba buccalis*, *Spirochæta buccalis*, and other Protozoa; *Dicrocœlium lanceolatum* in the bile-ducts of sheep and cattle, often along with *Distomum hepaticum*; *Sarcophaga wohlfahrti* in a child's ear and numerous other insects; the Acarids *Dermacentor reticulatus* and *Rhipicephalus expositicius* on sheep; 320 specimens of *Ascaris lumbricoides* passed from a woman in six weeks; and among Cestodes some interesting forms, e.g. *Diplogonoporus brauni* and *Braunia yassyensis*.

Tunicata.

New Species of Didemnoides.†—G. Daumézon describes *Didemnoides massiliense* sp. n., which is interesting in occupying an intermediate position between Diplosomidæ without spicules and Didemnidæ with perfect spicules. He found two forms together on the same support: (1) a black form with all the ectoderm pigmented, but with unpigmented embryos; and (2) a clear yellow form with unpigmented thoracic ectoderm and slightly pigmented visceral ectoderm, and with red embryos.

New Species of Pyrosoma.‡—G. Neumann describes *P. triangulum* sp. n., captured by the 'Valdivia' off Somaliland. The surface of the mantle was covered by lancet-like processes, resembling the appearance of *P. giganteum*. The individual animals are irregularly crowded together. The greatly arched dorsal surface and the much curved endostyle rising up posteriorly give the branchial sac a peculiar rounded triangular appearance.

Neumann § describes another new species, *P. ovatum*, from the South Atlantic. The form of the colony is unique in being oval or almost spherical. Here and there very long œsophageal tubes protrude from the surface. The epithelial lining of the œsophageal tube has large stellate pigment-cells, which are not represented in any other species.

New Species of Doliolum.‖—G. Neumann describes *D. resistibile* sp. n. from between 64° 29′ and 65° 32′ S. in the pack-ice region. It belongs to the sub-genus *Doliolina*, and has its nearest relative in *D. intermedium*, from which it is separated by the short endostyle and by the dorsal and ventral attachment of the branchia at the fourth muscle-band.

INVERTEBRATA.

Mollusca.

α. Cephalopoda.

Tentacular Apparatus of Cephalopods.¶—J. Guérin gives a detailed account of (1) the skin and its varied structure at different places; (2) the extremely complex musculature (brachial, acetabular, acetabulo-

* Bull. Med. Nat. Iasi, Nos. 9 and 10 (1908) pp. 1–9.
† C.R. Soc. Biol. Paris, lxv. (1908) pp. 179–80.
‡ Zool. Anzeig., xxxiii. (1909) pp. 792–4 (1 fig.).
§ Tom. cit., pp. 794–6 (3 figs.).
‖ Tom. cit., pp. 796–7 (1 fig.).
¶ Arch. Zool. Expér., viii. (1908) pp. 1–178 (4 pls. and 42 figs.).

brachial, acetabulo-cutaneous, and inter-brachial); (3) of the contraction and dilatation of the suckers; and (4) of the innervation. His research deals with *Octopus*, *Sepiola*, *Loligo*, *Sepia*, and other forms.

β. Gastropoda.

Snail on the Window-pane.*—M. Vlès discusses the cause of the noise sometimes made by a snail moving on the window-pane. He thinks the sound, which is very definite and periodic, is due to the shell rubbing against the glass. Another sound may be due to the radula rasping on the glass.

Movements of Gastropods.†—A. Robert discusses the movements of progression in *Haliotis*, *Helix*, *Chiton*, *Littorina*, and other Gastropods. He maintains that two modes of muscular undulation in the foot, from in front backwards, or from behind forwards, may cause progression, but the waves are not always equally distinct, and the matter does not seem to admit of short formulation.

New Prosobranch on Sea-urchins.‡—R. Koehler and A. Vaney describe three species of *Pelseneeria* g. n., which occur as ecto-parasites on *Echinus affinis* and *Genocidaris maculata*, with their proboscis fixed in the test. The new genus ranks with *Mucronalia*, *Stylifer*, and *Gasterosiphon* as a group of Eulimidæ.

Abnormal Tentacles in Water-snails.§—Albert Bauer has observed numerous specimens of *Planorbis* and *Limnæa* with abnormal tentacles. Thus, the distal half in *Planorbis corneus* may be thread-like and tapering; the tip in *Limnæa stagnalis* may be slightly forked or notched. These peculiarities are doubtless due to injuries.

δ. Lamellibranchiata.

Geological Interest of Distribution of Fresh-water Mussels.‖—W. Kobelt points out in an interesting paper that a careful study of the distribution of the species or sub-species of *Unio* in the Rhine and related river-systems is certain to throw light on the former geological relations.

Arthropoda.

α. Insecta.

Muscle Attachment in Insects.¶—W. A. Riley is unable to accept the view that the muscle-fibres are structurally prolongations of the chitinogenous cells. The evidence very strongly supports Maziarski's view that the so-called muscular fibrils passing through the hypodermal cells are in reality modifications of its own protoplasm—true tonomitomes.

* Bull. Soc. Zool. France, xxxiii. (1908) p. 145.
† Tom. cit., pp. 151–7 (2 figs.).
‡ Bull. Inst. Océanogr. Monaco, No. 118 (1908) 16 pp., 10 figs.
§ Zool. Anzeig., xxxii. (1908) pp. 773–5 (4 figs.).
‖ Verh. Nat. Ver. Preuss. Rheinland, lxv. (1909) pp. 151–62 (1 pl.).
¶ Ann. Entomol. Soc. Amer., i. (1908) pp. 265–9 (1 pl. and 1 fig.).

Nucleoli in Spermatocytes and Ova.*—Katharine Foot and E. C. Strobell have studied *Euschistus variolarius*, where there is a chromatin nucleolus (or more than one) in the entire growth-period of the spermatocytes. There is no corresponding body in the germinal vesicle. The authors discuss the significance of the chromatin nucleolus and the general question of the individuality and continuity of the chromosomes.

Injurious Insects and Acarines in Ireland.†—G. H. Carpenter discusses the common rustic moth, "turnip flies," various species of *Mamestra*, a new Irish springtail (*Isotoma tenella* Reuter), a new Irish larch sawfly (*Nematus maculiger* Cameron), the spruce aphid (*Chermes abietis*), and various other injurious insects. He has also notes on the common tick (*Ixodes ricinus*) of cattle, sheep and dogs, and three scab and itch mites, *Psoroptes communis* Furst, *Chorioptes bovis* Gerl., and *Sarcoptes scabiei*.

Do Drones Arise from Parthenogenetic Ova ?‡—L. Cuénot recalls Dzierzon's experiment of crossing the common black bee with the Italian bee which has its abdomen marked with yellow bands. If the drones are the results of parthenogenetic ova, then they should be all of the maternal type. But the results were contradictory. Possibly the queens that were used in the discrepant cases were themselves unsuspected hybrids.

Cuénot has crossed the common black bee (female), with the "golden bee" (male), both of pure races. The resulting workers had all yellow bands. Of about 300 drones, almost all were black, two had one large yellow abdominal band, a dozen had some yellow marks on the abdomen. Are these yellow marks hints of hybridisation, or simply of variation ? A search in hives has yielded no similar variants, which is against the second view. The experiment must be tried again.

Links between Solitary and Social Wasps.§—E. Roubaud reports on the habits of three species of *Synagris* (Eumenidæ), which nest on walls and under the roofs of houses in the Congo. In *S. calida* there is a large nest of a dozen chambers, which contains a store of caterpillars. In *S. sicheliana* there is a nest of eight chambers ; four or five paralysed caterpillars are put into the first cell beside the egg just before hatching, and the store is replaced as it is eaten. When the larva has reached about three-fourths of its size, the wasp shuts the entrance after putting in an appropriate number of caterpillars. Another cell is then made. In *S. cornuta* the nest has four or five chambers closely bound together, and the wasp feeds its young directly from chewed caterpillars, and there is no store. Thus there is a gradation between solitary and social wasps.

Mouth-parts of Wasps.‖—R. Kirmayer gives a detailed account of the structure and development of the mouth-parts in *Vespa vulgaris*, and compares them with the parts in *Apis*, *Bombus*, and other Hymenoptera.

* Biol. Bulletin, xvi. (1909) pp. 215–38 (3 pls.).
† Econ. Proc. R. Dublin Soc., i. (1908) pp. 559–88 (6 pls. and 10 figs.).
‡ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 765–7.
§ Comptes Rendus, cxlvii. (1908) pp. 695–7.
‖ Morphol. Jahrb., xxxix. (1908) pp. 1–30 (3 pls. and 6 figs.).

Inbreeding of Dilina tiliæ.*—Alfred Kolisko has continued inbreeding experiments for several years with this Lepidopterous species. It occurs in two main forms—a typical green form and a brown variety. The brown form is relatively constant, varying a little between a lighter and a darker reddish brown. The green form is extremely variable—from whitish green to dark olive green, and sometimes shows areas of brownish yellow. The greens produce greens and the browns browns. Crossing green and brown, results in some of the progeny being green and others being brown, but there is no blending of the two colours. Numerous varieties that have been named arise as degenerate changes in the course of inbreeding.

Ovaries of Pine Beetle.†—E. Knoche seeks to correlate a sort of dimorphism in *Myelophus piniperda* with its two modes of nutrition. It may eat under the bark of trees or in the young shoots. In the former case, the diet stimulates the sex-cells; there is premature senescence and weakening of the organism as a whole. In the other case, the soma is stimulated and the development of the gonads is slowed. Degenerative appearances in the ovary may be induced experimentally by starving the beetles.

Development of Donacia crassipes.‡—Jan Hirschler gives a detailed account of the development of this beetle. He deals with the differentiation of the blastomeres on to establishment of the ectoderm and the genital primordia; the segmentation of the blastoderm and the appearance of the appendages; the formation of the enveloping membranes and the differentiation of the so-called lower layer; the differentiation of the mesoderm, and the development of the alimentary canal and the blood-cells; the establishment of the vascular system, tracheal system, etc.; and the history of the genital primordia.

Eyes of Diptera.§—W. Wesché has studied a large number. The highly chitinised plate, pierced with circular apertures for the lenses, is the most primitive form. In higher forms the facets begin to be hexagonal and there is much less opaque chitin, until, finally, in specialised insects like the blow-fly (*Calliphora*), the opaque structure has quite disappeared, permitting all rays of light to enter the eye. The author has paid particular attention to the differences between the eyes of males and females. The greater amount of eye-surface in the male probably gives room for a greater number of facets, and thus the male is better able to find his mate. This extreme development of the eyes is well seen in Pipunculidæ, where the head of the male is almost entirely occupied by the compound eyes. But there are other sexual characters—the eyes of the male are often nearer one another; the eye of the male may be divided into an upper and a lower part, and it may be more pubescent.

* Verh. Zool. Bot. Ges. Wien, lviii. (1908) pp. 244–58.
† Verh. Deutsch. Zool. Ges., 1908, pp. 224–30.
‡ Zeitschr. wiss. Zool., xcii. (1909) pp. 627–744 (6 pls. and 15 figs.).
§ Journ. Quekett Micr. Club, 1909, pp. 367–84 (1 pl.).

Number of Segments in Muscid Larvæ.*—J. Pantel discusses the divergence of opinion as to the number of segments in Muscid larvæ. Some say that there are twelve, others that there are thirteen. Using the musculature and stigmata as guides, the author concludes that in addition to the pseudocephalic or buccal segment which supports the chief sensory papillæ, there are in the trunk proper eleven segments, four for the thorax and seven for the abdomen.

Braula and Thaumatoxena.†—C. Börner makes a detailed comparison of these two primitive genera, both parasitic, *Braula* adapted to living in the nests of bees, *Thaumatoxena* in those of termites. He makes a family for each genus, and points out that they are marked off from Pupipara by the flattening of the head—not dorso-ventrally, but from side to side—and by the absence of a hypopharynx, which all Diptera possess.

Endogamy in Termites.‡—Nils Holmgren admits that an exact proof of endogamy is wanting, but he has made observations that favour the view that it occurs in *Eutermes chaquimayensis.*

Morphological Character of Tracheal Gills.§—C. Börner has studied the tracheal gills of Ephemerids, and comes to the conclusion that they are of the nature of appendages. The facts of development, as stated by Heymons, points to the appendicular nature of the tracheal gills, and Börner shows in detail how this is borne out by the skeletal parts, the musculature, and the supply of tracheæ.

Reproduction of Phasmidæ.‖—J. Pantel and R. de Sinéty discuss the parthenogenesis that has been observed in isolated female Phasmids. In species with numerous males it has hitherto been found that the parthenogenetically produced offspring are all females.

But in an experiment with a species of *Dixippus*, the authors found that two males were produced, though most of the eggs developed into females or came to nothing. One of the females in the brood showed masculine characters in the posterior part of the body—a distinct gynandromorphism. The phenomena reported, of which we have given a sample, are very interesting, but there is evidently great need of more observations before conclusions are drawn.

Studies on Thysanura.¶—F. Silvestri establishes several new Lepismid genera—*Heterolepidella*, *Petalonychia*, *Atopatelura*, *Pseudatelura*, *Mesonychographis*, *Cryptocephalina*, all myrmecophilous or termitophilous, and describes various new species of *Lepisma*, *Japyx*, etc.

δ. Arachnida.

Lymphoid Glands in Scorpion.**—Iwan Sokoloff has studied in *Scorpio indicus* a pair of "lymphoid glands" which lie behind

* Comptes Rendus, cxlviii. (1909) pp. 233–6 (1 fig.).
† Zool Anzeig., xxxii. (1908) pp. 537–49 (9 figs.).
‡ Biol. Centralbl., xxix. (1909) pp. 125–8.
§ Zool. Anzeig., xxxiii. (1909) pp. 806–23 (4 figs.).
‖ Comptes Rendus, cxlvii. (1908) pp. 1358–60.
¶ Boll. Lab. Zool. Scuola Agric. Portici, ii. (1908) pp. 359–97 (24 figs.).
** Zool. Anzeig., xxxiii. (1908) pp. 497–503 (8 figs.).

Kowalevsky's lymphatic glands, that is to say behind the coxal glands at the boundary between cephalothorax and abdomen. The minute structure of the glands is described. No phagocytic activity was observed, but it was very marked on the lung-books.

Irish Spiders.*—Denis R. Pack-Beresford publishes a supplement to Professor Carpenter's list of 1898, adding no fewer than 58 species. Most of these are among the smaller and less common kinds, which, owing to their size, or the obscurity of their habitats, have been hitherto overlooked.

Arachnids of Caves.†—Angela Gozo gives a list of spiders and mites found in Italian caves, and distinguishes between those which may occur in caves and those which are strictly cavernicolous. The garden spider occurs in caves, but it is not cavernicolous like *Porrhomma proserpina*, or *Nesticus speluncarum*. He deals with 55 species, but the majority are not in the strict sense cavernicolous. Two new species are described, *Leptyphantes sardoa* and *Porrhomma pedemontanum*.

Mange in Rats.‡—W. Schürmann describes a cutaneous disease in rats, affecting especially the nose, ears, feet, and tail, and very seriously disturbing the health of the animals. It seemed to be due to a species of *Sarcoptes*.

Atax and Unionicola.§—W. Williamson agrees that the name *Atax* is invalid, as Oudemans and Walcott have shown, and that there is no choice but to replace it by Haldemann's *Unionicola*, which suggests the habitat of these fresh-water mites on the gills of fresh-water mussels. Thus *Atax ypsilophorus* must be changed to *Unionicola ypsilophorus* (Bouz.). Dura lex sed lex.

Demodex and Leprosy.‖—A. Borrel points out that in patients with nasal leproma the specimens of *Demodex* in the follicles and sebaceous glands are covered with microbes, and suggests that it is through *Demodex* that the disease passes from one host to another. Indirect evidence may perhaps be forthcoming by endeavouring to destroy *Demodex* in leprous patients and in those exposed to contagion. Treatment of the face with xylol and the like is suggested.

ε. Crustacea.

Experiments on Locomotion of Crabs.¶—Anna Drzewina refers to the well-known fact that a crab whose œsophageal nerve-ring has been cut on one side moves thereafter in a circle. She has observed, however, a very interesting fact, that after some time, e.g. a fortnight, the power of moving in a normal way is restored. It is not known how this is effected—whether by some auto-regulation within the nervous

* Proc. R. Irish Acad., xxvii., Section B, No. 7 (1909) pp. 87–118.
† Bull. Soc. Entomol. Ital., xxxviii. (1908) pp. 109–39.
‡ Centralbl. Parasitenk., xlviii. (1908) pp. 167–72 (7 figs.).
§ Proc. R. Phys. Soc. Edinburgh, xvii. (1909) pp. 223–4.
‖ Comptes Rendus, cxlviii. (1909) pp. 50–1.
¶ C.R. Soc. Biol Paris, lxv. (1908) pp. 320–2.

system, or by making compensatory movements, or otherwise. The animal experimented with was *Carcinas mænas*, but analogous experiments with other forms are being made.

Regeneration in Atya serrata.*—E. Bordage has given reasons for believing that *Atya serrata* Spence Bate has arisen by mutation from *Ortmannia alluaudi* Bouvier, and he offers an interesting corroboration of this view in the fact that removal of the chelipeds is followed by a regeneration after the *Ortmannia* type, what he calls a "hypotypic regeneration."

Bathynomus giganteus.†—R. E. Lloyd gives an account of the internal structure of this large Isopod, and describes the sexually mature males. The specimen dissected was 193 mm. in length and 89 mm. in breadth. The hepatopancreas is quite different from that of other Isopods. It consists of three pairs of elongated glandular organs, each of a simple racemose type. This is probably correlated with the large size of the animal, for the minute structure is like that of the simple tubular glands of smaller Isopods. The author has been able to give a full description of the nervous system and of the internal skeleton of the head. There are nearly three thousand facets in each eye.

"The large vitrellæ, which are remarkably clear and translucent the well-developed black pigment, which not only separates these lenses but spreads out and covers them peripherally like an iris, and the well-developed, pigmented terminations of the retinula cells, all point to the conclusion that the eye of *Bathynomus* is a useful, light-perceiving organ. This fact lends support to 'the theory of abyssal light,' for *Bathynomus* is essentially a deep-water form which does not seem to be a recent emigrant from shallow waters."

The eggs are 11 mm. in diameter—probably the largest recorded Crustacean eggs. The memoir includes among its fine illustrations an interesting photograph of a living female sweeping the water with its pleopods—a movement which secures aeration of the blood in the peculiar branchial tufts.

Colours of Hippolyte varians.‡—Romuald Minkiewicz has evoked a great variety of coloration by keeping the animals in a glass aquarium with the floor and walls covered with paper of the desired colour. He got simple colours—red, yellow, and blue; and mixed colours—orange, olive, violet, brown, green. Some of these colours—bright yellow, blue, and violet—do not occur in the natural environment of seaweed; and the author concludes from this that the "synchromatic plasticity" of the chromatophores is not due to natural selection, but is a capacity of a primary order, directly dependent on external chromatic factors.

A floor of blue and a floor of white both produce contraction of all the chromatophores and a blue coloration. The changes are produced on adults as well as on the young. Any variety can be changed into any other.

* Comptes Rendus, cxlviii. (1909) pp. 47–50.
† Memoirs Indian Museum, i. (1908) pp. 81–102 (4 pls. and 8 figs.).
‡ Comptes Rendus, cxlvii. (1909) pp. 943-4.

South Australian Marine Isopods.* — W. H. Baker describes a number of new Sphæromidæ. He discusses the close resemblances of the sexes when young, and their subsequent divergence. It seems that the mature females which bear young may perish in the effort, being sometimes apparently eaten by the brood. The following new forms are dealt with :—*Cymodoce longicaudata* sp. n., *C. hamata* sp. n., *Dynamene ramuscula* sp. n., *Amphoroidea angustata* sp. n., *Amphoroidella elliptica* sub-g. et sp. n., *Moruloidea lacertosa* g. et sp. n., *Dynamenopsis obtusa* g. et sp. n., *Circeis trilobata* sp. n., *C. obtusa* sp. n., and *Haswellia cilicioides* sp. n.

Annulata.

Oligochæta of the British Isles.†—Rowland Southern offers contributions towards a monograph of the British and Irish Oligochæta. The only species peculiar to the British Isles are *Eiseniella macrura* Friend and *Helodrilus relictus* sp. n. The age of the Irish earthworm fauna is attested by the absence of the sub-genus *Eophila*, and the presence of a small group of species having a discontinuous distribution of the Lusitanian type, admittedly the oldest in our fauna. Southern believes that in some way the fauna survived the Ice Age, either in Ireland, or in some neighbouring land free from ice, and in connection with Ireland. He deals with 135 British species and sub-species—79 in England, 48 in Scotland, 22 in Wales, 16 in the Isle of Man, 96 in Ireland.

Regeneration of Anterior Portion of Chætopterus.‡—Ch. Gravier recalls the fact that the anterior portion of this well-known tubicolous Annelid can regrow the whole, and describes a case (*Chætopterus variopedatus* Renier), in which the posterior region was re-growing the anterior part, and re-growing it perfectly. There are usually 9 or 10 anterior setigerous segments, there are rarely 11, and very exceptionally 12 ; in the regenerated specimen described there were 12, which shows that "nature has not here manifested the economical tendencies often ascribed to her."

Nephridia of Salmacina and Filograna.§—A. Malaquin finds that the nephridial apparatus in the adults of these two genera corresponds to a proto-nephridium. In its great simplicity and in its minute structure, e.g. with flagella inserted directly on the internal wall, the adult nephridium resembles the proto-nephridium of the larvæ of Annelids and Molluscs.

Study of Tubificidæ.‖—W. Michaelsen finds that the setæ are not of much diagnostic value, that the structure of the nervous system is useful in referring a type to one of the larger divisions of the family, that the characters of the vascular system depend much on size and mode of life, and that the details of the nephridial apparatus are

* Trans. R. Soc. South Australia, xxxii. (1908) pp. 138–62 (8 pls.).

† Proc. R. Irish Acad., xxvii., Section B, No. 8 (1908) pp. 119–82 (5 pls. and 3 figs.).

‡ Comptes Rendus, cxlviii. (1909) pp. 365–7.

§ Op. cit., cxlvii. (1908) pp. 699–701.

‖ Arch. Natur., lxxiv. (1908) pp. 129–62 (1 pl.). See also Zool. Zentralbl., xv. (1908) p. 682.

constant in some groups of forms and variable in others. He believes that the most reliable data are got from the male reproductive system, e.g. from the details of prostate, "paratrium," penis. It is important to note whether the spermothecæ contain spermatophores or merely a mass of sperms. Various species are discussed, e.g. *Branchiura sowerbyi*, Bedd., *Taupodrilus coccineus* Vejd., *Clitellio arenarius* Müll., *Tubifex nerthus* sp. n.

Leydig's Punktsubstanz in Nerve-cord of Leech.*—E. Mencl discusses the significance of this substance. He finds that it is not one thing but several. It consists of nervous elements or neuro-fibrils, and of neuroglia, the former arising from neuroblasts, the latter from spongioblasts. There is no essential difference between the "Punktsubstanz" of leeches and the grey matter of Vertebrates; both are the results of the intimate combination of a nervous feltwork and a connective-tissue feltwork.

Supporting Tissue of the Nervous System of Leeches at the Anterior and Posterior Ends.†—A. W. Jakubski finds that in the reduced neurosomites in *Clepsine* and *Piscicola* the number of glia cells is not altered, but there is change as regards position, shape, and size in correspondence with the reduction of the neurosomites. He discusses the state of the glia cells in detail, and some of his conclusions can be stated in summary. Thus he finds in the topographical and structural characters of the cerebral glia tissue, and in the minute structure of the "brain" as a whole, emphatic reasons for not regarding the brain as homologous with the ventral ganglia. The œsophageal commissures are not equivalent to those in other parts. They arise from the coalescence of the lateral portions of the brain and a certain number of sub-œsophageal ganglia, and the connective primordia uniting these.

Nematohelminthes.

Classification of Strongylidæ.‡—A. Railliet and A. Henry apply the term Ankylostominæ to those Strongylidæ that have a buccal capsule. They then take into consideration the sides of the caudal bursa and the position of the vulva, and divide the Ankylostominæ into five subfamilies. They also define four new genera.

Ascaris canis and Ascaris felis.§—H. Glaue finds that the species *A. canis* Werner and *A. felis* = *A. mystax* Rudolphi are readily distinguished. The dog Ascarid is twice the size of the cat parasite; the so-called "wing" ridges are different in shape; the caudal papillæ differ in number and arrangement.

Filaria in Human Spleen.‖—Rheindorff reports finding a minute *Filaria* larva in a splenic tumour in a patient who died of nephritis and diabetes.

* Zeitschr. wiss. Zool., lxxxix. (1908) pp. 371–416 (2 pls.).
† Bull. Internat. Acad. Sci. Cracovie, 1909, pp. 854–92 (1 pl.).
‡ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 168–71.
§ Zool. Anzeig., xxxiii. (1909) pp. 785–90 (3 figs.).
‖ Centralbl. Parasitenk., xlvi. (1908) pp. 332–6 (1 fig.).

New Tapeworm from Wild Duck.*—T. B. Rosseter describes *Hymenolepis acicula sinuata*, a new species of tapeworm from *Anas boschas fera*. A striking feature is the absence of a cirrus and its accessories. No actual coition takes place, but merely impregnation in its primitive form of transmission. In place of an elaborate copulatory apparatus there is a simple infundibuliform canaliculus genitalis.

Parasites on Zeus faber.†—J. Fiebiger describes superficial growths on the skin of this fish, which were found to be caused by a larval Distomid Trematode in the sub-genus *Echinostomum* Rud. Other parasites that often occur encysted in the skin of fishes are *Ichthyophthirius* and *Holostomum*.

Trematodes from Birds.‡—L. A. Jägerskiöld describes *Spelophallus primas* g. et sp. n. from the oyster catcher, a type very near *Spelotrema*. From a gull (*Larus marinus*) he got *Spelotrema excellens* Nicoll; from the ringed plover, *Maritrema linguilla* sp. n.; from the common sandpiper, *M. subdolum* sp. n. He gives a useful synoptic table of species of *Maritrema*. It is pointed out that the small Monostomid cysts (of *Galactosomum lacteum*), often seen on the brain of *Cottus scorpius*, become adult in the cormorant.

New Species of Monostomum.§—A. Arnsdorff describes from *Arquatella maritima* a new species of *Monostomum* which he calls *M. vicarium*.

Planaria alpina in Auvergne.||—A. Bruyant reports that in springs of the Alpine zone, where the temperature is about 4° C., the only Planarian is *P. alpina*; in springs with a temperature of 4–6° C. *P. alpina* occurs, or *Polycelis cornuta*, or both; in springs with temperatures above 6° C., *P. alpina* was not found. As Zschokke points out, *P. alpina* is a stenothermal Glacial species.

Regeneration in Nemerteans.¶—C. Dawydoff describes the regeneration of the posterior end in a large species of *Cerebratulus*. The re-growth takes place wherever the cut is, even when it is close behind the mouth. The regenerated part differs from the rest of the body in size and colour. If the head is removed from the piece the re-growth of the posterior part is much slower, and the same is true in *Saccocirrus*, *Protodrilus*, and other Annelids. It is probable that the absence of the cephalic ganglia slows the regeneration. The rate also varies with the temperature of the water, the age of the worm, the size of the piece, etc. All the organs may be regenerated except the gonads. A careful account of this organogenesis is given.

* Journ. Quekett Micr. Club, 1909, pp. 393–402 (1 pl.).
† Centralbl. Parasitenk., xlvii. (1908) pp. 62–9 (2 figs.).
‡ Op. cit., xlviii. (1908) Abth. i., pp. 302–17 (7 figs.).
§ Op. cit., xlvii. (1908) pp. 362–6 (2 figs.).
|| Comptes Rendus, cxlvii. (1908) pp. 937–8.
¶ Bull. Acad. Imp. Sci. St. Pétersbourg, vi. (1909) pp. 301–11 (12 figs.).

Incertæ Sedis.

Animal of Doubtful Affinity.* — Baldwin Spencer describes as *Hologlœa dubia* a peculiar organism thrown up on the shores of the southern coast of Victoria. It has the form of a mass of stiff jelly with four sides and an oral and aboral end. The mouth lies in the middle of the oral surface, and leads into a flask-shaped cavity. From the central point of its distal end there arises a very small but distinct tube, which runs up to and opens on a conical projection on the aboral surface. The distance between oral and aboral surfaces is 11 mm. Each of the four margins is bounded by a very distinct band of finely punctated material. Four of the fourteen specimens showed an "oral organ," a small horse-shoe shaped process, a little like a stolon. It may be that this enigmatical organism is a nurse-form in the life-history of some animal.

Echinoderma.

Luminescent Ophiuroids.†—Emanuel Trojan finds that the seat of luminescence in *Ophiopsila annulosa* and *O. aranea* is in glandular cells, that the luminescence is intracellular, and that it occurs under the direct influence of the nervous system.

Nucleus and Cytoplasm in Sea-urchin Development.‡ — E. Godlewski, jun., finds evidence during the segmentation-period of a transformation of cytoplasm into nucleoplasm. Increased temperature, salinity, and alkalinity increase the frequency of cell-divisions, and thus influence the absolute quantity of chromatin. The size of the plasmic areas which gather round the individual nuclei is dependent on the size of the nuclei. These are three of the many interesting conclusions reached by the author.

Echinoderm Larva from Lower Silurian.§—Anton Fritsch discusses what Barrande called "furca bohemica"—a minute flat disk with four processes. The margins bear quadrangular plates as in some star-fishes. On the middle of the smooth disk there is a rounded elevation. Fritsch draws the remarkable conclusion that "the furca was probably the pluteus of a Crinoid."

Cœlentera.

Species of Hydra.‖— A. Brauer discusses the various species. Besides *H. viridis* (which Pallas called *H. viridissima*) there are: (1) *H. vulgaris* Pall. (= *H. grisea* L., *H. aurantiaca* Ehrenberg, *H. rubra* Lewis, *H. trembleyi* Haacke, and probably *H. attenuata* Pallas); (2) *H. oligactis* Pall. (= *H. fusca* L., *H. roeselii* Haacke, *H. rhætica* Asper, *H. monœcia* Downing, *H. diœcia* Hefferan); and (3) *H. polypus* L. (= *H. aurantiaca* Korotneff, *H. fusca* Brauer, Hefferan, and Downing). Definitions of the three species are given.

* Proc. R. Soc. Victoria, xxi. (1909) pp. 401–9 (2 pls.).
† Arch. Mikr. Anat., lxxiii. (1909) pp. 883–912 (1 pl.).
‡ Bull. Internat. Acad. Sci. Cracovie, 1908, pp. 522–6.
§ Zool. Anzeig., xxxiii. (1909) pp. 797–8 (1 fig.).
‖ Tom. cit., pp. 790–92 (2 figs.).

Transverse Division in Hydra.*—W. Koelitz notes that this mode of multiplication occurs in the ponds in autumn as well as in spring. It must be of some importance in the multiplication of the polyp.

New Plumularid in the 'Challenger' Collection.†—A. Billard describes *Plumularia kirkpatricki* sp. n., based on fragments in the 'Challenger' collection. He also notes a new variety—*elongatus*—of *Thecocarpus myriophyllum*, and makes some corrections in nomenclature.

Commensalism of Fish and Hydroid.‡—V. Franz and E. Stechow refer to a fish obtained by Doflein in Sagami Bay which was covered with a hydroid, as previously described by Alcock. E. Stechow describes the hydroid—*Stylactis minoi* Allman—and notes that it had well developed medusoids and should perhaps be referred to the genus *Podocoryne*. Franz has some notes on the fish, *Minous inermis* Alcock.

Leptomedusæ of San Diego.§—H. B. Torrey finds that these present a well isolated group. Of the eleven dealt with, ten are new. The new genus *Scrippsia* is distinguished from its nearest relative, *Polyorchis*, by the gastric peduncle and the absence of pinnately arranged branches of the radial canals distal to the gonads. The new genus or sub-genus *Tiaropsidium* is proposed for *Tiaropsis*-like forms with tentacles of two kinds, four or eight large, and a varying number of much smaller, more or less rudimentary tentacles between them. The new genus *Phialopsis* is proposed for *Phialidium*-like forms with a few (16–22) long tentacles, numerous rudimentary tentacles, marginal cirri, and numerous large statocysts.

Medusoids from East Africa.‖—Cl. Hartlaub reports on a collection of Mesudoids made at Djibuti by Ch. Gravier. The collection is interesting because it concerns a region of which little is known in this connection. Hartlaub describes three new species—*Eutimalphes modesta*, *Octorchandra orientalis*, and *Amphogona pusilla*—and a number of others previously known. The collection also included *Cassiopeia andromeda* Eschr., one of the Acraspeda.

Fission and Autotomy in Sea-anemones.¶—G. Bohn reports the frequent occurrence of rapid fission in *Anthea cereus*. A constriction of the body is effected, and the mesenteries re-arrange themselves in each of the two parts. Slight impurity of the water or rapid change in illumination may provoke the fission. That fission is going to occur is often indicated by differences in the reactions of the two halves. After the rupture the two new individuals have often different tropisms. In one case the autotomy of all the tentacles of the outer whorl was observed. Wounds do not seem to have much to do with the autotomy.

* Zool. Anzieg., xxxiii. (1909) p. 783.
† Comptes Rendus, cxlvii. (1908) pp. 758–60.
‡ Zool. Anzeig., xxxii. (1908) pp. 752–4.
§ Univ. Californian Publications (Zool.) vi. (1909) pp. 11–31 (11 figs.).
‖ Zool. Jahrb., xxvii. (1909) pp. 447–76 (5 pls.).
¶ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 936–9.

Green Pigment of Actinia equina.*—G. Bohn reports on a number of experiments which have led him to the conclusion that the green pigment of *Actinia equina* has an assimilating role, like the pigment of *Anthea cereus*, so that the anemone is able to utilise CO_2 in sunlight. Two phenomena occur together, as in green plants—respiration and assimilation.

Protozoa.

New Technitella and its Selection of Shell Material.†—E. Heron-Allen and A. Earland describe *Technitella thompsoni* sp. n. from the North Sea. In the construction of its test "the utmost limit hitherto observed, both as regards construction and selection, is reached." The test is free, sub-cylindrical, rounded, and slightly tapering at one extremity and bluntly truncate at the other, consisting of a hollow chamber with composite walls built up entirely of echinoderm plates in more or less perfect condition. The plates which overlap each other are fastened together without visible cement. There is no special aperture at either end of the test, the extremities being closed by means of similar plates set at an angle, so that they resemble the incurving petals of a flower. The surface of the test is neat and regular and entirely devoid of extraneous matter, but the projecting edges of the flat (or slightly curved) plates used in the construction of the test give a somewhat irregular or serrate appearance to the outline. It is hyaline white, with a slight iridescence when dry, due apparently to diffraction effects caused by the film of chitin with which the plates are probably fastened together. The length is 1·8 mm.; the maximum breadth ·4 mm. The nearest ally seems to be *T. raphanus*. In neither of the dredgings in which the two specimens were found was there any abundance of echinoderm plates. The problem of the selection is discussed.

Botryomycosis.‡—G. Bureau and A. Labbé have studied a case of this strange and rare disease, which they attribute to an amœba. Four forms occur: (*a*) a spherical or spheroidal stage, sometimes flattened, with lobose pseudopodia, large nucleus, and great activity; (*b*) a more regularly rounded form, often flattened, with thick ectoplasm, with the nucleus achromatic or invisible. It seems that (*b*) results from (*a*) and marks the end of the vegetative stage. Then there is (*c*) a regressive form, flattened, irregular, showing hyaline or pigmentary degeneration, and (*d*) a fusiform, Gregarine-like stage, with delicate ectoplasm, and compact, very chromatic nucleus.

There is multiplication by transverse division amitotically. But mitosis is exhibited in the (*d*) form. Mulberry-like masses, the old *Botryomyces*, represent plastogamy. The form (*a*) gives rise to "echinocysts." It seems likely that (*a*) and (*d*) represent a sexual dimorphism.

* Comptes Rendus, cxlvii. (1908) pp. 689–92.
† Journ. Quekett Micr. Club, 1909, pp. 403–12 (6 pls.).
‡ Comptes Rendus, cxlvii. (1908) pp. 697–9.

Cockroach's Parasites.*—C. Janicki describes the structure and life-history of three parasites found in the hind-gut of *Periplaneta orientalis*—*Lophomonas blattarum* Stein, *L. striata* Bütschli, *Amœba blattæ* Bütschli.

Flagellates in Blood of Fresh-water Fishes.†—E. A. Minchin discusses some trypanosomes and trypanoplasms of fresh-water fishes which he studied at the Sutton Broad Laboratory in 1907 and 1908. The first part of his paper is devoted to an instructive discussion of the methods and technique employed. The author believes that drying the films deforms the parasites, more especially the trypanoplasms; he recommends fixation with osmic vapour, if the Romanowsky stain is to be employed. He is, however, dissatisfied with the misleading effects produced in the nucleus by this stain, and points out that the results obtained with Heidenhain's iron-hæmatoxylin (after Schaudinn's sublimate-alcohol or an allied fixative) are quite different, and probably much more trustworthy. Then follow general remarks on the parasites—their movements and structure. The author successfully demonstrated the myonemes in the trypanosomes of the perch and eel with the aid of iron-hæmatoxylin. The extraordinary disparity in size between different individuals in the same blood was not satisfactorily accounted for—in some cases appearances favoured the sexual hypothesis, in others—e.g. *T. granulosum*—they suggested growth-stages merely. The rarity of dividing forms is commented on, and the suggestion made that multiplication may take place in the internal organs of the fish. Experiments on the mode of transmission by leeches gave negative results.

This interesting paper concludes with detailed descriptions of *Trypanosoma percæ* Brumpt, *T. granulosum* Lav. and Mesn., *T. remaki* Lav. and Mesn., *T. tincæ* Lav. and Mesn., *T. abramis* Lav. and Mesn., *Trypanoplasma abramidis* Brumpt, and *Trypanoplasma borreli* Lav. and Mesn., and in addition two new trypanoplasms are described,—*Trypanoplasma gurneyorum* sp. n., from the pike, and *Trypanoplasma keysselitzi*, sp. n., from the eel.

Trypanosomes of Cold-blooded Animals.‡—G. Bouet finds a trypanosome in *Sternotherus derbianus*, which he regards as distinct from that which Robertson found in *Emyda vittata*. In *Tropidonotus ferox* Günther there is a parasite like *Trypanosoma rotatorium* or *mega* of the frog. Two species of trypanosome have been reported from lizards of the genus *Mabuia*; the author reports another new form. There are two in a toad, *Bufo regularis*, and *T. toddi* occurs in the fish *Clarias anguillaris*.

Influence of Alcohol on Life-cycle of Infusoria.§—Lorande L. Woodruff has experimented with *Stylonichia* and *Paramœcium*. The chief results are the following:—(1) Minute doses of alcohol will decrease the rate of division at one period of the life-cycle and increase it at another. (2) When alcohol increases the division rate, the effect is not continuous,

* Atti (Rend.) R. Accad. Lincei Roma, xvii. (1905) pp. 140–51.
† Proc. Zool. Soc. London, 1909, pp. 2–30 (4 pls.).
‡ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 609–11.
§ Biol. Bulletin, xv. (1908) pp. 85–104.

but gradually diminishes, and finally the rate of division falls below that of the control, followed by fluctuations above and below the rate of the control. (3) An increase (doubling) of the amount of alcohol administered, however, will again cause a more rapid cell-division for a limited period. But again the effect is not constant, since the rate of division falls below the control, and is followed by fluctuation above and below the division rate of the control. The amount of alcohol was doubled three times, always with the same result. (4) Treatment with alcohol lowers the resistance of the organisms to copper sulphate.

Trypanosome in European Bison.*—K. J. Wrublewski describes a trypanosome from the bison (*Bos bonasus*) in the forest of Bielovege (Bielowesch). It may be noted that only two species of pathogenic trypanosomes are known in Mammals of temperate zones, viz.: *T. rougeti* and *T. theileri*, but there is no evidence that this form in the bison, which is quite distinct, is pathogenic. A. Wladimiroff and W. Yakimoff † testify to the newness of the bison trypanosome, for which the name *T. wrublewskii* sp. n. is suggested.

Balantidum coli in Macaque Monkey.‡—F. Noc describes a case of dysentery in *Macacus cynomolgus*, which seemed to be due to *Balantidium coli*, an Infusorian known to occur in some forms of human dysentery.

Hæmogregarines of the Lizard.§—C. França describes several species of *Hæmogregarina* from *Lacerta ocellata*—*H. schaudinni* França, a new variety, *africana*, of the same, *H. curvirostris* Billet, *H. biretorta* Nicolle, *H. nicollei* sp. n., and *H. minuta* sp. n.

Studies on Sarcosporidia.‖—A. Negri has studied *Sarcocystis muris*, and finds evidence that a definite and regular process of division goes on in the spores. The significance of this division is obscure.

Parasites from Lobster's Intestine.¶—L. Léger and O. Duboscq describe *Anoplophrya minima* sp. n., a mouthless Ciliate; *Aggregata vagans* Lég. et Dub.; *Porospora gigantea* E. van Beneden; and *Selenococcidium intermedium* g. et sp. n. The schizozoites of this new genus are like the young vermiform stages of *Porospora*, but there is a schizogonic cycle quite different from that of the *Porospora*. The chief interest of *Selenococcidium* is that its vegetative stages are those of a Schizogregarine (*Selenidium*, *Siedleckia*), while its sexual process is that of a Coccidian.

Costia as a Trout-parasite.**—Louis Léger discusses the disastrous results due to *Costia*, which so frequently attacks trout-fry. It is very important to avoid feeding the larvæ on material from infected waters. Hofer recommends treating the infected fry for half an hour with salt water (20–25 gr. of sea-salt in 1000), but this is difficult when there

* Centralbl. Parasitenk., xlviii. (1908) pp. 162–3 (1 pl.).
† Tom. cit, p. 164.
‡ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 878–80 (1 fig.).
§ Arch. R. Ist. Bacter. Camara Pestana, ii. (1909) pp. 339–60 (1 pl.).
‖ Centralbl. Parasitenk., xlvii. (1908) pp. 56–61 (2 pls.).
¶ Comptes Rendus, cxlviii. (1909) pp. 363–5. ** Tom. cit., pp. 1284–6

are large numbers, and it is not without its risks. Léger has tried, with great success, placing the fry for 15 minutes in formolated water (0·4 gr. of the commercial solution in a litre of water). This treatment also cuts off *Gyrodactylus*, another troublesome parasite.

New Microsporidian.*—Charles Perez describes from *Termes lucifugus* a new microsporidian parasite which he calls *Duboscquia legeri* g. et sp. n. It may be ranked along with *Glugea*, for in both the element that issues from the spore grows without dividing, and forms a large trophozoïte inclosing numerous spores.

Hæmogregarines in a Pentastomid.†—S. Prowazek found *Hæmogregarina pythonis* Bill. in the blood of a Java python. In the python there were four Pentastomids (*Porocephalus moniliformis*) and in the alimentary canal of these there were more Hæmogregarines. There was evidence that they had continued to develop in the Pentastomid.

* C.R. Soc. Biol. Paris, lxv. (1908) pp. 631–3.
† Zool. Anzeig., xxxiii. (1908) pp. 465–6 (2 figs.).

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Structure and Development.

Vegetative.

Aerial Roots of Tibouchina Moricandiana.*—B. Chandler has studied the aerial roots of *T. Moricandiana*. These roots usually arise from the nodes of the upper branches, and are from 10–15 cm. long; they are mostly negatively geotropic. They are short-lived, and have no great functional activity. When cut off and grown in soil the roots lengthened but did not branch, but if forced under the soil while still in connection with the stem, they gave off lateral roots and behaved like ordinary aerial roots under similar conditions. The root-tip of these aerial roots dies rapidly and the tissues around continue to grow until a swelling like a callus-cushion surrounds the dead tip. From this callus a circlet of roots may grow out, or the swelling may form a bilobed root or even a fasciated structure. The most curious phenomenon exhibited by these roots is the manner in which an inner cambium derived from the pith completes the severed portions of the vascular system found in each lobe of the root. Xylem and phloem are developed in normal sequence but in inverted position in respect to the pith cambium.

Parasitism of Lathræa clandestina.†—M. Col contributes a note upon *L. clandestina*, which has lately appeared as a parasite upon the vines in the lower Loire district. The root-suckers differ from those of *L. Squamaria* in being of larger diameter and fewer number; they do not ramify, but are of the "compact sucker" type. The new host does not appear to have modified the structure of the parasite. It is also strange to find that this plant, which is usually regarded as characteristic of humid districts, has invaded a soil which is dry and has a stony subsoil.

Physiology.

Nutrition and Growth.

Green Plants and Carbon Monoxide.‡—Th. Kraschenіnnikoff has made a number of experiments upon green plants, in order to discover whether a green plant exposed to light can obtain its carbon directly from this gas. The experiments have been made under the most varied conditions, but they all tend to show that no absorption takes place. Further, the presence of CO has no effect upon the decomposition of CO_2. In spite of these negative results the author does not

* Notes Roy. Bot. Gard. Edinburgh, xx. (1909) pp. 247–250 (1 pl.).
† Comptes Rendus, cxlviii. (1909) pp. 1475–76.
‡ Rev. Gén. Bot., xxi. (1909) pp. 177–93 (1 pl.)

consider that there is sufficient evidence to prove that carbon monoxide may not be an intermediate product in the assimilation of CO_2. "It is possible that it takes part in reaction in the nascent state, or perhaps that the simultaneous formation of other substances may be necessary in order that assimilation may take place."

Absorption of Water by Seeds.*—W. R. G. Atkins has experimented with seeds of *Phaseolus vulgaris* and *Lathyrus odoratus*, with the following results. Bean seeds, living or dead, take up the same amount of water in initial stages, and the final weight reached is independent of the presence of KNO_3. Distilled water is not absorbed more rapidly than salt solution. Seeds placed in solution of KNO_3 and then in water, lose weight, but the final weight is what it would have been if they had been placed direct in pure water. N/0 H_2SO_4 solution, N/10 iodine and N/10 sodium chloride, are practically unchanged in concentration by having seeds soaked in them, but iodine is decolorised. Thus, seeds have no semipermeable membrane till germination begins and cell-protoplasm becomes active. There is no difference between the absorption of dead and living seeds until the commencement of germination, since capillarity and imbibition are the forces concerned before germination, but afterwards osmosis comes into action.

Respiration of the Aerial Parts of Vascular Plants.†—G. Nicolas contributes a note upon some experiments which he has performed upon *Pirus communis*, *Nerium Oleander*, etc., with the purpose of investigating the cause of the greater respiratory energy of leaves when compared with that of the stem, petiole, etc. When the leaves were covered with vaseline the respiratory energy was decreased and the ratios CO_2/O and 1/N were increased. Thus the author concludes that the greater respiratory energy of the leaves is due to the greater facility for the penetration and circulation of gas, which they present.

Irritability.

Germination of Phacelia.‡—E. Heinricher has investigated the results produced by change of light during the germination of *P. tanacetifolia*, and finds that the rays of the first half of the spectrum and also ordinary diffused light are unfavourable to germination, while darkness and the rays of the second half of the spectrum are advantageous. Seeds which have been sown immediately after harvest are especially sensitive to the retarding influence of light. If seeds which are to be germinated in darkness are previously kept dry for a short time, it is found that the percentage of good germinations is largely increased, but seeds sown in the light are unaffected by this treatment. In its response to the influence of light *Phacelia* greatly resembles *Veronica peregrina*. The reason of this influence must be sought in the photochemical action brought about in the food-reserve. It would appear that the effect of the fat-splitting lipase is favoured by the formation of acid that takes place in darkness, while light prevents this process to a greater or lesser extent in proportion to its intensity.

* Sci. Proc. Roy. Dublin Soc., xii. (1909) pp. 35–46.
† Comptes Rendus, cxlviii. (1909) pp. 1333–36.
‡ Bot. Zeit., lxvii. (1909) pp. 45–66.

General.

Triple Hybrids.*—H. de Vries has investigated hybridisation in *Œnothera*. Triple hybrids were produced by crossing *O. strigosa*, *O. Hookeri*, and *O. biennis* with *O. lata* and *O. scintillans*. Of these triple hybrids, two are the same as the twins from the similar crosses with *O. Lamarckiana*, while the third resembles the mother, but in some particulars is intermediate between its parents. It seems probable that the splitting up of the offspring of the crosses should result in the formation of quadruple hybrids.

Pollination of Dendrobium.†—A. F. G. Kerr has investigated the mode of pollination in various species of *Dendrobium*. In *D. Dalhousieanum*, which is described as being typical of all the species examined, the bee (*Lithurgus atratus*) forces its way to the nectary and its weight depresses the lip sufficiently to allow it to insert its proboscis into the nectary. As it retreats it displaces both the rostellum and the anther, owing to special jointed arrangements in these structures. The tilting of the rostellum causes it to come into contact with the pollinia and deposit on them a sticky secretion. The pollinia, being further tilted, come into contact with the bee's thorax and adhere to it. As the bee leaves the flower, the elasticity of the filament brings the empty anther in front of the entrance to the passage, which it thus blocks. If a bee now enters an unfertilised flower, the pollinia come into contact with the stigma and adhere to it, but if the flower has been previously entered, it merely pushes back the empty anther, and the latter then adheres to the stigma and prevents the deposit of any more pollen. When self-pollinated by artificial means, the flower soon withered away.

Flora of the Malayan Peninsula.‡—The two last issued instalments of this work, which was originated by the late Sir George King, and is being continued by J. S. Gamble, contain accounts of the following families of sympetalous Dicotyledons :—Apocynaceæ and Asclepiadaceæ, elaborated by Gamble; Loganiaceæ, by Sir Geo. King, excepting *Strychnos*, which is by Gamble; Acanthaceæ, by the late C. B. Clarke; and Labiatæ and Plantaginaceæ, by Lt.-Col. Prain.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A. F.L.S.)

Structure of Selaginella Lyallii.§—H. Bruchmann gives an account of the vegetative organs of *Selaginella Lyallii*. In the summary of his results the author says that the growing point consists of initial cells, from which all the apical tissues arise, therein agreeing with *S. spinulosa* and *Lycopodium*. The branching primarily appears to be

* Bot. Gaz., xlvii. (1909) pp. 1–8.
† Sci. Proc. Roy. Dublin Soc., xii. (1909) pp. 47–53 (2 pls.).
‡ Journ. Asiatic Soc. Bengal, lxxiv. pt. 2, extra Nos. (1907) pp. 387–728.
§ Flora, xcix. (1909) pp. 436–64 (figs.).

dichotomous, but by one-sided growth becomes monopodial. In the rhizome, the main branch is shorter than the frond branch; in the frond the main branch grows quicker than the lateral. The bundle of the rhizome consists of inclosed funnel-shaped tubes fitting into one another and separated by ground tissue. In the lateral branches of the rhizome, the outer tubes form meshes. In transverse section, the rhizome exhibits one, two or more concentric bundle-rings separated by ground tissue or transitional tissue. Primary tracheids occur on the periphery of the outer xylem ring. Weak rhizomes possess a central cylindric immature bundle, with central xylem surrounded by phloem and sheath, and growing by central additions. The fronds arising from the rhizome possess in their stalks a number of single parallel bundles. In weak fronds are found only a double bundle or two single ones. These bundles increase to ten or more and anastomose; in transverse section they appear arranged in three rows. Epidermis and cortex have normal structure. The lower leaves of the rhizome differ much in structure from the highly differentiated aerial leaves. The rhizophores are produced only at the points of branching of the rhizome and remain short and simple. They arise exogenously from prismatic initials, and their brief meristematic apical growth is soon changed to intercalary, and during the latter mode of growth the root is differentiated. The root at its apex shows a sharp differentiation into three layers of meristem. There is the independent root-cap with the calyptrogen; the root covered by the dermatogen; and the periblem and plerome. The root, like the stem, is dichotomously branched, and, owing to unequal development, becomes monopodial. The roots arise only from the rhizophore and are produced endogenously; their rudiments exhibited a well-marked dermatogen. The structure of root and rhizophore is normal, and these two are distinguished by the structure of their epidermis. No endophyte was found in the rhizoids.

Anatomy of Isoetes.*—A. G. Stokey gives an account of the anatomy of *Isoetes*, based upon American species. In a summary of her results, she says: 1. The vascular axis is a non-medullated monostele, composed of tracheids and parenchyma; there is no differentiation into protoxylem and metaxylem. 2. No primary phloem in stem; it occurs only in leaf-traces and root-bundles. 3. Cambium produces cortex outside and secondary xylem inside, and forms no phloem. 4. Secondary xylem consists of various combinations of the following: Spiral or annular tracheids; immature tracheids (either slightly lignified or unlignified, with irregular rings or spirals, or with pits, nucleate or enucleate); parenchyma with more or less protoplasm. 5. Zonation in secondary xylem depends on the species. 6. Root-bundles are collateral and monarch; protoxylem is endarch. 7. Leaf-traces are collateral, becoming concentric in upper part of leaf. The xylem is much reduced above the sporangium. The sieve-plates are transverse. 8. Near the vascular axis the leaf-trace does not show differentiation into protoxylem and metaxylem. In the outer cortex and near the sporangium it is usually exarch.

* Bot. Gaz., xlvii. (1909) pp. 311–35 (3 pls.).

Abnormal Sporocarp of Salvinia.*—A. J. Gray publishes a note on an abnormal sporocarp of *Salvinia natans*, containing both megasporangia and microsporangia, an abnormality only once before observed. Normally the Hydropterideæ have the two sets of sporangia in separate sporocarps. In *Azolla*, in the microsori the megasporangium aborts at an early age; in the megasori the microsporangia fail to develop. In *Salvinia*, on the other hand, this abortion of mega- and micro-sporangia respectively is not found save in very rare abnormal cases.

Floats and Stripes in Marsilia.†—G. Senn gives an account of the float-bladders and intercostal stripes of a New Caledonian aquatic form of *Marsilia*. The formation of the floats depends upon the enlargement of certain radially arranged air-chambers, such as occur in other parts of the leaf-stalk. The intercostal stripes on the underside of the leaf are composed of small straight-walled epidermis cells, rich in tannin and not developed beyond the embryonal stage, clearly owing to malnutrition. The brown colour is due to tannin-derivatives.

Adventive Buds in Ceratopteris.‡—W. Baily writes about the adventive buds and allied structures on the primary leaves of ferns. He sums up his results as follows. 1. The earliest stages of the adventive buds of *Ceratopteris thalictroides* showed two large cells. 2. From these cells arise a stem-apical cell and a leaf-apical cell. 3. The rudiments of the second leaf originate in a segment of the stem-apical cell. 4. On the later leaves adventive buds arise in similar fashion. 5. The adventive buds on the primary leaves of *C. thalictroides* do not germinate in a normal manner. 6. To make them develop one must cut off the leaves, or cut off the apical cell, or cut through the vascular bundles of the leaf. 7. Buds cut off and cultivated on *Sphagnum* develop leaves of simplified structure. 8. The prothalloid outgrowths on the primary leaves of *Polypodium aureum* received from Goebel show a tendency to branch, the lobes being of a leaf-like character, and one of them produces the apical cell. 9. The formation of the apical cell was retarded by malnutrition. 10. In *P. lycopodioides* some structures intermediate between prothallia and leaf-like outgrowths were successfully elicited on the primary leaves.

Fossil Equisetaceæ and their Structure.§—P. H. Fritel and R. Viguier give an enumeration of the fossil species of *Equisetum*, calling special attention to those the tubers of which are known. Having obtained good material, they describe and figure the structure of the tubers of *E. stellare* and the stems of *E. noviodunense*. Their studies show that the structure is the same as that of present day species, and that the genus is no more likely to have altered in its internal morphology than in its external. And once more is demonstrated how indispensable it is to study the anatomy of fossil plants, since paleontologists of high repute have mistaken the tubers of *E. stellare* for fruits of palms or of Rubiaceæ.

* Notes Roy. Bot. Gard. Edinburgh, xx. (1909) pp. 251–2 (pl.).
† Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 111–19 (pl. and fig.).
‡ Flora, xcix. (1909) pp. 301–10 (figs.).
§ Rev. Gén. Bot., xxi. (1909) pp. 129–42.

Nature of Algal or Boghead Coal.*—E. C. Jeffrey discusses the nature of so-called algal or boghead coals, which have been described as consisting of the remains of oil-containing groups of gelatinous green algæ. The opacity and brittleness of material make the preparation of slides sufficiently thin for satisfactory examination almost impossible. Chemical treatment of the coal was without result until the following method was devised :—exposure to nitro-hydrofluoric acid for a time; careful washing; soaking in hot alcohol containing from 3 to 5 p.c. of fixed alkali. The coal swells and softens without cracking, and after infiltration with nitro-cellulose, can be cut with the razor into very thin sections, which can be bleached with nitric acid and strong chlorine water. It is then found that these coals consist not of algæ, but of macrospores of vascular Cryptogams. The "algæ" are, in fact, only the pores in the strongly sculptured coats of these macrospores. The typical tri-radiate ridge is present. The "algæ" have been named *Thylax*, *Pila*, and *Reinschia*.

Adaptation of Ferns to Light.†—L. Lämmermayr publishes a further contribution on the adaptation of ferns to different strengths of light. His investigations were made upon species of the Mediterranean and Alpine regions *Ceterach officinarum*, *Cheilanthes fragrans*, *Adiantum Capillus-Veneris*, *Asplenium Adiantum-nigrum*, *A. serpentini*, *Aspidium rigidum*, *Scolopendrium vulgare*. Among his general conclusions he says that the only native fern which enjoys the fullest exposure to bright light is *Pteridium aquilinum*. In the second line come *Ceterach*, *Cheilanthes*, *Asplenium*, xerophilous species of walls and rocks.

Urostachys, a subgenus of Lycopodium.‡—W. Herter publishes a contribution to a knowledge of *Lycopodium*, especially the subgenus *Urostachys*. He has studied the collections of eighteen herbaria. After giving a résumé of previous works treating of the subject, he devotes a chapter to the consideration of the characters which are available for the systematic classification of the species. The mode of ramification is of the greatest value in *Urostachys*, being a regularly repeated dichotomy. Next, the leaves are of great importance, according to their close or scattered disposition on the stem, their erect or spreading position, their texture, size and form; also the colour of the axis and leaves. The members of *Urostachys* are all mesophytes and grow on humus. Reproduction takes place by means of spores and much more by bud-production. *Urostachys* flourishes mainly in the tropics, especially in tropical America and in the East Indies. The author provides a key to the subgenera and sections, and arranges the 140 species in systematic order, giving descriptions of 48 that are new to science.

North American Ferns.—J. H. Ferriss § gives an account of the ferns of Cochise county in the south-east corner of Arizona. Some sixty species of ferns and fern-allies have now been reported for the

* Rhodora, xi. (1909) pp. 61–3.
† X. Jahresber. k.k. Staatsgymn. Leoben, 1898, pp. 3–14 (pl.). See also Hedwigia, xlviii. (1908) Beibl., p. 116.
‡ Engler's Bot. Jahrb., xliii. Beibl. No. 98 (1909) 56 pp. (4 pls. and figs.).
§ Fern Bulletin, xvii. (1909) pp. 1–7.

county. The author describes the physical geography of the district, its canyons, etc., and the habitats adopted by the different species of ferns. A. E. Scoullar * publishes some notes on *Botrychium*, *Osmunda*, *Onychium*, and other ferns. W. N. Clute † describes and figures four new aberrant forms of *Osmunda regalis* and *O. cinnamomea*. He also publishes ‡ some more additions to his Check-list of North American Fernworts. F. C. Greene § publishes notes on the ferns of six counties in the State of Indiana, and briefly indicates the geological features of each area. W. N. Clute ‖ gives an account and figure of *Rhipidopteris peltata*, a small trailing fern of the American tropics. He also publishes ¶ under the title Pteridographia a series of notes on the following subjects: colour of fern-spores; the curious "leaf-shoots" of *Dicksonia pilosiuscula*; the aromatic glandular hairs of that species and its mycorhiza; the fertile leaves of *Nephrodium cristatum*; *Polypodium aureum Mandaianum*, a new form.

New Ferns from South America.**—A. Sodiro publishes descriptions of thirteen new species of *Acrostichum* from Ecuador, with a short key. E. Rosenstock †† publishes descriptions of seventeen new species and varieties of ferns collected by O. Buchtien in Bolivia, together with a list of fifty ferns already known. H. Christ ‡‡ supplies descriptions of eight new species and varieties of ferns collected by E. Hassler in Paraguay. C. Christensen §§ describes a new species of *Dryopteris* collected in Brazil by A. Heiner.

Bryophyta.

(By A. Gepp.)

Absorption of Water by Mosses and other Plants.‖‖—K. Müller gives an account of some experiments made with sundry bryophytes and lichens with a view to determining their capacity for absorbing moisture from fallen rain, etc., and from aqueous vapour suspended in the atmosphere.

Abnormal Bracts in Funaria hygrometrica.¶¶—H. N. Dixon describes a remarkable form of *Funaria hygrometrica* from the half-dried mud of a reservoir in the Pentland Hills. The margins of its perigonial bracts throughout almost their entire length are furnished with closely set and often double serratures, the marginal cells being inflated at their apex into a sort of hammer-head. This he makes clear by a series of figures. In trying to find out their meaning, Dixon thinks that the primary end gained by them is the storage of extra water; and he compares them with the paraphyses. He gives an imaginary sketch of

* Fern Bulletin, xvii. (1909) pp. 7-8 and 18-20.
† Tom. cit., pp. 9-12.
‡ Tom. cit., pp. 20-1.
§ Tom. cit., pp. 12-15.
‖ Tom. cit., pp. 16-18 (1 pl.).
¶ Tom. cit., pp. 22-5.
** Fedde's Repertorium, vi. (1909) pp. 276-82.
†† Tom. cit., pp. 308-16.
‡‡ Tom. cit., pp. 348-51.
§§ Tom. cit., pp. 380-1.
‖‖ Pringsheim's Jahrb. wiss. Bot., xlvi. (1909) pp. 587-98.
¶¶ Bryologist, xii. (1909) p. 48-51.

the appearance of a primitive ancestral *Funaria*, and suggests that in the Pentland Hills plant we have a reversion towards the primitive organs of the ancestral plant.

Photomicrography of Mosses.*—W. B. Davis describes a method of making photomicrographs of mosses and hepatics—an easy thing to do in most cases, the Microscope preparations being as a rule fairly transparent. Quite simple apparatus will with care afford good results.

Fauna of Mosses.†—F. Richters has been studying the fauna of moss-tufts, and gives an account of the Invertebrata found in a collection of mosses brought back by the German Antarctic Expedition from the Island of Ascension, and also in mosses from the Comoro Islands, from Sumatra and Java.

Moss Galls.‡—M. Spindler describes the character of some Nematode-galls on *Webera nutans*, apparently not noticed before on this species, and certainly not mentioned in V. Schiffner's paper on moss-galls in the same journal three years ago. Spindler believes that in *W. nutans*, as in other species, the galls are produced by *Tylenchus Davainii* Bast., an Anguinule or Nematode-worm.

Bryological Notes.§—V. Schiffner continues his bryological notes. 53. On *Riccardia sinuata*, three different forms of which were gathered by E. Stolle in Saxony last summer. One of these is described as a new var. *subincurvata*. 54. On *Riccardia major*. Schiffner objects to C. Müller's making this species a mere variety, and maintains that it cannot be regarded as a synonym of *R. sinuata*, which is always aquatic or subaquatic, and has a greater number of cell-layers in the transverse section of its stem. 55. Occurrence of *Neesiella carnica* in lower Austria and Hungary. The plant was known previously only from the Italian Carnic Alps; but now it has been recorded from several stations between the Eastern Alps and the Hohe Tatra. 56. On *Lophozia acutiloba*, recorded from two stations near Salzburg, from one of which came the original specimen of *Jungermannia inflata* var. *nigricans* Nees, the description of which corresponds closely with that of *Lophozia acutiloba* var. *heterostipoides*. 57. On an interesting form of *Brachythecium campestre*. It is polygamous. He also publishes ‖ an account of two critical hepatics of the European flora, *Aplozia Schiffneri* and *Lophozia acutiloba*, discussing their morphology and relationships in considerable detail, and defining their distribution. He gives careful figures of habit and structure.

European Species of Drepanocladus.¶—G. Roth publishes a review of the European species of *Drepanocladus*, embodying the conclusions to which he has come after studying a rich series of specimens from swamps in Livland sent to him by W. von Bock. He insists upon the

* Bryologist, xii. (1909) pp. 47.
† Ber. Senckenberg. Nat. Ges. Frankfurt, 1908, pp. 14–26.
‡ Hedwigia, xlviii. (1909) pp. 203–4 (pl.).
§ Oesterr. Bot. Zeitschr. lix. (1909) pp. 84–9.
‖ Hedwigia, xlviii. (1908) pp. 184–90 (figs.).
¶ Op. cit., (1908) pp. 152–77 (3 pls.); 1909, pp. 212–14.

necessity of studying the very variable forms of this genus at all times of year, and during all the varying conditions that affect the stations in which they grow—dampness and drought, varying richness of the water, etc. He disagrees with the views of L. Loeske, who, he considers, has gone too far in separating off from *Drepanocladus* his genera *Warnstorfia* and *Limprichtia*. Also he differs from Sanio's views as to the section "*binervia*," and considers that some of the species are closely related to *Hypnum*. *Hypnum fertile* is, he says, a *Drepanium*, and not a *Drepanocladus*. The groups of *Drepanocladus* as arranged by Roth are as follows:—(1) *Vernicosus* (*Limprichtia* of Loeske); (2) *Uncinatus* (*Sanionia* of Loeske); (3) *Sentneri*; (4) *Aduncus* (with two new species); (5) *Exannulatus*; (6) *Fluitans* (with one new species); (7) *Furcatus* (with one new species). Several new forms are described.

In a subsequent communication the author states that he has received further rich material from the same source, containing several new forms, which he briefly describes. In consequence of the unusually dry season new forms and varieties of *D. capillifolius* appeared, also a very sturdy plant of the *Exannulatus* group, which he describes as var. *decurrens*. *D. furcatus*—the connecting link between the *Furcatus* group and *Limnobium ochraceum*—might just as well be referred as a variety to the latter species. He records also the discovery of the first sporogonium of *Fontinalis seriata*.

Phascum lotharingicum, a New Species.*—A. Coppey describes *Phascum lotharingicum*, a new species gathered in sandy fields near Nancy and Lunéville. It is distinguished by its very shortly rostellate ovoideo-globose capsule borne on a sigmoid pedicel; its short lobed calyptra; its globose echinulate spores; its ramification; its apical leaves strongly papillose on each side above the middle; and its concave very carinate perichætial leaves which hide the sporogonium. The author regards it as a widely distributed species which has been confounded with other species, and he shows how it may readily be distinguished from *Acaulon*, *P. Floerkeanum*, *P. cuspidatum*, *P. rectum*, *P. curvicollum*, and *P. dubium*.

Sphagnum subsecundum and its Allies.†—C. Jensen discusses the *subsecundum* group of European Sphagnaceæ, and compares the views of Warnstorf and of Russow. He follows the latter, but attaches greater importance to the character of the stem-cortex. He gives a useful key, based first on the presence or absence of pores in the branch-leaves; secondly, on the number of layers of cortical cells.

Key to Orthotrichum.‡—W. Krieger publishes a well-elaborated key to the European species and forms of the genus *Orthotrichum*, employing, not the stomata, but other characters obvious to the naked eye.

Calypogeia trichomanis and its Allies.§—C. Meylan publishes some further studies on *Calypogeia trichomanis* and its allied forms, especially

* Rev. Bryolog., xxxvi. (1909) pp. 77–80.
† Lotos, lvi. (Prag, 1908) pp. 234–8. ‡ Tom. cit., pp. 317–23.
§ Rev. Bryolog., xxxvi. (1909) pp. 53–8.

var. *Neesiana* and var. *sphagnicola*. He admits that K. Müller and Massalongo offer strong reasons for raising the var. *Neesiana* to specific rank, and himself inclines to regard it as a xerophilous form which is tending to differentiate itself more and more. He would regard it rather as a sub-species than as a variety. He discusses its points of difference from *C. trichomanis*, its variability, its habitat, its synonymy. With regard to *C. trichomanis* var. *sphagnicola*, he gives the results of his observations of the varying forms of *Calypogeia* in two neighbouring bogs in the Jura range, and states that the vegetative structure of var. *sphagnicola* differs only in size from that of sphagnicolous forms of *C. trichomanis*. He gives a series of figures of the different forms of the amphigastria found in var. *sphagnicola*.

Distribution of Timmia megapolitana.*—V. Torka writes of the occurrence of *Timmia megapolitana* Hedw. in the province of Posen. He found it near Nakel, and mistook it at first for *Catharinea undulata* (which it very closely resembles) until he found a single old capsule. It was associated with *Betula humilis*, *Bryum bimum*, *B. intermedium*, *Philonotis marchica*, *Riccia glauca*, and *Marchantia polymorpha*. The species was first found about 120 years ago at Malchin, in Mecklenburg, and subsequently in West Prussia, on the island of Rügen, and at Lauenburg. The author has kept the Posen plant under observation, and describes the growth of the sporogonium, though most of the young capsules were killed by the winter. He is led to believe that the species will yet be found in the Mark Brandenburg.

Monograph of the World's Mosses Completed.†—V. F. Brotherus publishes the concluding fascicles of his monograph of the Musci in Engler's Pflanzenfamilien. After finishing the remaining seven genera of Brachytheciaceæ, he treats of the Hypnodendraceæ (four genera), and gives a supplement of 66 pages comprising numerous additions that have arisen since the printing of the text. This is followed by an index of the genera recognised in the work. On page 1172 the author explains in a note his reasons for giving so elaborate an account of the mosses of the world. Since the Synopsis Muscorum of Carl Müller was published more than half a century ago, no monograph of the mosses has appeared; but meanwhile, in numerous papers, multitudes of new species have been described, and these badly needed to be grouped into genera based on a definite system. He adds a few words on the system of classification adopted by Fleischer in his still unfinished Moss-flora of Java.

Moss Exchange Club.‡—The Moss Exchange Club has published its Fourteenth Annual Report, containing lists of mosses and hepatics gathered by the Fellows. In several cases critical notes are appended. Anglicised descriptions of *Riccia Crozalsii* Levier, *Aplozia caespiticia* Dum., and two varieties of *A. riparia*.

By the same Club § is issued an Exchange List of European Mosses,

* Hedwigia, xlviii. (1908) pp. 142–4.
† Leipzig: Engelmann, 1909, lief 234–5, pp. 1153–1246, title pages, etc. (figs.)
‡ York: Coultas and Volans, 1909, pp. 295–327.
§ York: W. Ingham (1909) 4 pp.

compiled by W. E. Nicholson for the Club from Roth's "Europäische Laubmoose," and other sources, a compact list of genera, species and varieties on one folded sheet, intended for ready circulation by post.

British Fossombroniæ.*—A. S. Horne publishes some observations on *Fossombronia*. Having collected specimens of this genus in Devonshire, Surrey and Durham, and finding their identification to be uncertain, he gives some statistics to show the great variability of the spore markings. He describes also the situations in which the specimens were growing and the plants with which they were associated; also the habit of the specimens during life. He demonstrates the presence of amphigastria more or less fugitive and filamentous.

Catharinea rhystophylla C.M. in Britain.†—H. N. Dixon reports the result of a critical examination of *Catharinea rhystophylla* and *C. angustata*. The latter species is native; the former, a Chinese species, has been reported from Ireland this year. *C. rhystophylla* was distinguished by C. Müller from its congeners by its transversely rugulose leaves. Dixon shows that there is no line of demarcation between the *C. rhystophylla* of C. Müller and the extreme form of *C. angustata* as described by Limpricht. He therefore defines *C. angustata* var. *rhystophylla*, and gives its distribution as far as known: China (Shensi); Austria (Coglio); England (Kent); Ireland (Co. Down).

Bryophytes of Somerset.‡—W. Watson and W. Ingham publish a list of bryophytes of Somersetshire, containing forty-three mosses and twenty-nine hepatics, with localities, representing new records for the county.

Bryophytes of Leicestershire.§—A. R. Horwood gives lists of all new records of Cryptogamia for Leicestershire between 1886 and 1907, including numerous bryophytes, and states the localities of the rare and interesting species. He also tabulates those species which have disappeared from the county and those which had been erroneously recorded in time past. He devotes a chapter to the ecology and distribution of cryptogamous plants in Leicestershire.

Irish Mosses.—J. H. Davies ‖ publishes a list of thirteen mosses of Co. Down and eleven of Co. Louth, several of which are new records for the respective counties. Notes on the more interesting species are appended. *Ditrichum tenuifolium* and *Fissidens crassipes* had only once before been gathered in Ireland, and the latter species was without any definite locality. *Aulacomnium androgynum* and *Amblyodon dealbatus* are very uncommon in Ireland. Sterile specimens of a *Philonotis*—apparently *P. capillaris*—were also found.

The same author ¶ publishes a note on *Barbula Hornschuchiana*, which though very rare in Ireland has been recently found in Co. Down

* Journ. Bot., xlvii. (1909) pp. 182–4.
† Tom. cit., pp. 212–14.
‡ Tom. cit., pp. 178–80.
§ Trans. Leicester Lit. Phil. Soc., xiii. (1909) pp. 15–86.
‖ Irish Naturalist, xviii. (1909) pp. 12–14.
¶ Tom. cit., p. 23.

and Co. Armagh. He also withdraws the record of *Archidium alternifolium* in Co. Down as incorrect. The plant, always sterile, is now suspected to be a form of some species of *Dicranella.*

French Mosses.*—A. Coppey has written an account of the Muscineæ of Nancy, hitherto but little known. He corrects Godron's list of 1843, and adds a supplement of 103 mosses, seven sphagna, and twenty-three hepatics. He also adds much information about bryological study and local exploration.

Moss-flora of Norway.—J. Hagen † begins a series of monographs upon the moss-flora of Norway with an account of the Orthotrichaceæ, viz., *Zygodon*, *Ulota*, *Orthotrichum*, *Strömia*, and *Aulacomitrium*. *Strömia* is a new genus created for the reception of *Orthotrichum obtusifolium* and *O. gymnostomum* on account of their peculiar leaf-shape. *Glyphomitrium Daviesii* is transferred by the author to the exotic genus *Aulacomitrium*. The geographical distribution of the species is carefully worked out.

The same author ‡ gives an account of the moss-herbarium of the late E. Ryan (born 1849, died 1905), treating the records therein contained on the lines of geographical distribution. Thus the paper consists of a series of little moss-floras for eleven Norwegian counties or administrative areas.

Bryology of Tornean Lapland. — H. N. Dixon gives an account of a visit with W. E. Nicholson to Abisko in Tornean Lapland in August 1907. He describes the physical geography of the district, and divides it into three regions: upland, birch-wood bogs, river ravines. The river ravines provide the best collecting ground. An annotated list of 216 mosses and 47 hepatics is given. In a long note the relationship of *Mnium hymenophyllum* and *M. hymenophylloides* is discussed. The author is convinced that *M. hymenophylloides* is a variety at most, in fact not much more than a rupestral form of *M. hymenophyllum*, being a form modified by growing in rock-crevices. The reasons for this view are fully stated. *M. hymenophylloides* is the older name. The species appears distinct from *Cinclidium*. But the fruit has not yet been found.

Bryophytes of the Algau Alps.||—L. Loeske publishes a critical study of the bryophytes of the Algau Alps. Among his most important results are: 1. The new genus *Barbilophozia*. 2. Discussion of the causes of dark coloration of some species. 3. The influence of illumination. 4. Critical examination of *Pohlia*. 5. Critical examination of *Philonotis*. 6. Systematic arrangement of the Brachythecieæ into Eustegiaceæ and Brachystegiaceæ. 7. Synonymy of *Brachythecium densum*. 8. On *Hypnum molluscum* var. *robustum*. 9. Changes of nomenclature. 10. Critical study of *Thuidium hystricosum*. 11. On *Neesiella rupestris*. 12. New forms or species.

* Bull. Soc. Sci. Nancy (1908) 74 pp. See also Rev. Bryolog., xxxvi. (1909) p. 52.
† K. Norske Vidensk. Selsk. Skrift, 1907 (Trondhjem, 1908) No. 13, 100 pp. (figs).
‡ Op. cit., No. 1, 36 pp.
§ Rev. Bryolog., xxxvi. (1909) pp. 27–36, 58–66.
|| Verh. Bot. Verein. Prov. Brandenburg, xlix. (1907) pp. 30–65. See also Hedwigia, xlviii. (1909) Beibl. pp. 168–70.

Austrian Mosses.—J. Glowacki * publishes a contribution to our knowledge of the moss-flora of Carinthia, and describes the new species *Thuidium hygrophilum* which grows in the spray of the Gössnitz waterfall near Heiligenblut with *Hypnum procerrimum* and *Didymodon giganteus* at an elevation of 4500 ft. It resembles *T. abietinum* in habit. The other novelties are two varieties and a form. Many species which prefer silex were found on the carboniferous slates and limestone of the Gailthal.

The same author † gives an account of the moss-flora of the Backergebirge, the most easterly spur of the Southern Alps. This range is composed of granite covered with crystalline rocks and cretaceous and tertiary strata. After treating of the distribution of the mosses, the author enumerates the rarer species with their altitudes. The total flora is 384 mosses and 109 hepatics.

F. Matouschek ‡ continues his studies of Bohemian mosses. In revising the collections in the Prag Landes-museum, he has found moss records for east, west, south and middle Bohemia. The nomenclature employed by the old botanist forms an interesting synonymy.

J. Rompel § publishes a list of mosses collected in Vorarlberg and Tyrol, supplemented by others from Valais and the lower Rhone Valley, with careful annotations as to altitude.

Hungarian Mosses.—V. Schiffner ‖ gives an enumeration of forty-two hepaticæ of Hungary and Transylvania sent to him by I. Györffy.

I. Györffy ¶ gives an account of "Polykarpophorie," i.e., the production of several sporogonia from the archegonia of one and the same perichætium, as occurring in eleven different species of mosses.

He also ** gives an enumeration of twenty-three rare mosses gathered by himself and others in Transylvania, North Hungary, and elsewhere.

J. Szurak †† publishes some additions to the moss-flora of North Hungary. He treats of the physiological and ecological condition of the Bryophytes, which he classifies according to Filarszky's scheme, viz. into: 1. Autophyta with independent nutrition, (*a*) Hydrophyta; (*b*) Euphyta, including Xerophyta and Mesophyta; (*c*) Aërophyta or Epiphyta. 2. Allophyta, including the saprophytes and parasites. The author enumerates 92 mosses and 23 hepatics, and 15 species recorded by other authors. He gives some figures of structure.

Hepatics of Dalmatia and Istria. ‡‡—V. Schiffner gives an account of some hepatics collected by J. Baumgartner in Dalmatia and Istria, which, he says, make it clear that the hepatics of Dalmatia show an unmistakable affinity with those of North Africa and of the environs of Florence, and that some species regarded as typically west European

* Jahrb. Natur. Landesmuseum Karnthen, xxviii. (1908) pp. 165–86.
† Jahresb. k.k. Staatsgymn. Marburg, 1908, pp. 1–30.
‡ Mitt. Ver. Natur. Reichenb. 1908, pp. 13–48.
§ 17 Jahresb. Gymnas. Stella Matutina Feldkirch, 1908, pp. 65–74.
‖ Magyar Bot. Lapok, viii. (1909) pp. 24–33.
¶ Tom. cit., pp. 40–7. ** Tom. cit., pp. 51–3.
†† Novén. Kozlem. vii. (1908) pp. 87–115 (figs.).
‡‡ Hedwigia, xlviii. (1908 and 1909) pp. 191–202 (figs.).

have a distribution much further eastwards; for instance, *Marchesinia Mackayi*, *Cololejeunea Rossettiana*, *Dichiton calyculatum*, *Fossombronia verrucosa*, *F. Husnotii*, *Riccia Henriquesii*, *R. subinermis*, *R. macrocarpa*, *Prionolobus dentatus*, *P. Turneri*. Baumgartner's specimens were collected almost exclusively at Quarnero and the Dalmatian island of Arbe. The present list contains 45 species, 20 of which are additions to the Dalmatian flora since Schiffner's last paper on the subject in 1906. *Fossombronia Loitlesbergeri* is a species new to science, and is figured.

Dalmatian Hepaticæ.* — V. Schiffner publishes under the title Hepaticæ Latzelianæ, a contribution to a knowledge of the hepaticæ of Dalmatia. Until 1906 only 20 species were known from that country; and Schiffner then added 18 species collected by Baumgartner, and saw that Dalmatia promised to be one of the most interesting areas for hepatics in Europe. That promise has proved true. A remarkable collection of 201 species has been made by A. Latzel in Ragusa, and is described in the present paper. Among them is *Dichiton calyculatum*, with ripe sporogonia, now for the first time figured and described. Dalmatia in its hepaticæ shows an affinity with North Africa and Tuscany.

Moss-flora of the Austrian Coast-lands.† — K. Loitlesberger gives a list of 145 species collected in this district, which was first explored sixty years ago by O. Sendtner. Descriptions of two novelties are given—*Archidium alternifolium* var. *pictum* and *Phascum arbense*.

Bosnian Mosses. — J. Glowacki‡ publishes some notes on Bosnian mosses, including descriptions of two new species—*Ctenidium distinguendum* and *Eucladium commutatum*.

J. Glowacki § supplies a more complete description of his *Ctenidium distinguendum*, recorded from Bosnia, Dalmatia, and Triest; and points out the characters by which it is distinguished from *C. molluscum*, viz. by its thin sigmoid seta, its almost regular capsule, and the long appendages on the cilia of the inner peristome.

Bryogeographical Note on Polytrichum alpinum in Servia.‖ — N. Kosanin writes of the occurrence of *Polytrichum alpinum* upon a peat-bog by a lake situated at the elevation of 5200 feet in the Golia Mountains in south-west Servia. The species has once before been reported from a peat-moss, viz. near Stuhm in North Germany. The author describes the environment of the plant in the Servian locality. The lake contains pure rain-water. The marginal vegetation has advanced to the middle of the lake, leaving but a small amount of free-water surface. Towards the middle is a floating vegetation, a mossy carpet of *Sphagnum subsecundum* and *S. medium* held together by the felted roots of *Carex canescens*. From the *S. subsecundum* arise large deep-green patches of *Polytrichum alpinum*, which below stand directly in the swamp-water. The plants grow luxuriantly and produce abundant fruit in mid-July.

* Verh. k.k. Zool. Bot. Ges. Wien, lix. (1909) pp. 29–45 (figs.).
† Tom. cit., pp. 51–67.
‡ Oesterr. Bot. Zeitschr., lix. (1909) pp. 51–3. § Tom. cit., pp. 91–2.
‖ Hedwigia, xlviii. (1909) pp. 205–6.

Muscineæ of Servia.*—N. Kosanin publishes an enumeration of twelve mosses and thirty-two hepatics from the Golia Mountains of south-west Servia, mostly collected in the pinewood zone, and partly representing additions to the moss-flora of Servia.

Sicilian Bryophyta.†—G. Zodda writes about the occurrence of *Riccia glauca* L. in Sicily and its affinity with *R. commutata* Jack. *R. glauca* var. *major* was abundant in parts of the Messina Botanic Garden in 1905 and less frequent in 1906. Since the latter date it has not appeared. Zodda gives reasons for the views that *R. commutata* is a parallel species to *R. glauca*, having a xerophilous adaptation and a southern distribution; that the presence of *R. glauca* in Sicily is to be regarded as doubtful; that the recent presence of *R. glauca* var. *major* Lindb. in Sicily must be regarded as accidental.

He also publishes ‡ a third contribution on the bryophytes of Sicily gathered in various districts by L. Nicotra and others. He gives a list with localities of 83 species of mosses and 25 hepatics; 10 mosses and 2 hepatics are new records for Sicily.

Mosses of Madeira.§—A. Luisier contributes a second note on the mosses of Madeira collected by C. de Menezes, which contain three varieties new to science, ten species new to Madeira, and six species and three genera new to the Atlantic islands.

North American Mosses.—T. C. Frye ‖ describes a peculiarity in a specimen of *Neckera Menziesii*, a moss very common on trees in Washington territory, especially on *Acer macrophyllum*. Its branches were all densely flagelliferous and ramified at the ends, the leaves on the flagella being veinless and reduced to one-tenth the normal size. The flagella were brittle, and might serve as a means of vegetative propagation, but the reason for their formation is obscure.

A. L. Andrews¶ cites an explanation by Nawaschin of the spore dispersal of *Sphagnum*. Experiment showed him that the drying of the mature capsule compresses the air contained in it and leads to an explosive discharge of the spores.

A. J. Grout** gives a list of twenty-one hepatics collected in North Carolina, and describes the moss-flora on a stunted yellow birch—eleven mosses and four hepatics.

A. J. Hill †† writes of the seasonal changes of the moss-flora in his district. In 1904, for instance, large spaces were covered with a luxuriant growth of *Mnium insigne*. Next year it was entirely replaced by smaller species of *Mnium*. In one year a certain lawn was covered with a minute sterile growth of *Mnium*; and in the following year it was as densely covered with *Hylocomium triquetrum*. What is the reason for these changes?

Mexican Mosses.‡‡—J. Cardot publishes some preliminary diagnoses of Mexican mosses collected by C. G. Pringle, C. Purpus, W. Trelease.

* Hedwigia, xlviii. (1909) pp. 207–9.
† Malpighia, xxii. (1908) pp. 499–505.
‡ Tom. cit., pp. 506–21.
§ Bull. Soc. Port. Sci. Nat., ii. (1908) pp. 52–4.
‖ Bryologist, xii. (1909) pp. 52–3.
¶ Tom. cit., p. 35.
** Tom. cit., p. 54.
†† Tom. cit., pp. 54–6.
‡‡ Rev. Bryolog., xxxvi. (1909) pp. 67–77.

In spite of the work done by Schimper, Bescherelle and C. Müller, much remains to be learned about the mosses of Mexico, for out of 75 species determined by Cardot in the families Sphagnaceæ-Pottiaceæ, not less than 34 species and 5 genera are new, and these novelties occur chiefly in the Pottiaceæ. The five new genera are *Pringleella* (Dicranaceæ), *Husnotiella*, *Dactylhymenium*, *Trichostomopsis*, *Aloinella*, the four latter belonging to Pottiaceæ. About a score of new species are described.

Mosses of the Pacific.*—V. F. Brotherus enumerates 78 species of mosses from Samoa, among which were 12 Samoan species new to science and 21 new to the various islands. They were collected by K. Rechinger during his expedition to Samoa, New Guinea and Solomon Islands in 1905.

Mosses of Bombay Presidency.†—H. N. Dixon publishes an account of a score of mosses collected by L. J. Sedgwick and R. M. Maxwell in the southern part of the Bombay Presidency, and mostly on the Western Ghâts, but partly in the Kanara jungles nearer the sea. He describes two new species: *Pterobryopsis Maxwellii* and *P. kanarensis*, and proves the identity of *Erpodium Bellii* Mitt. with *E. Mangiferæ* C. Muell.

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

Italian Characeæ.‡—L. Formiggini gives a list of six species of *Nitella* and eleven of *Chara* collected in the district of Lazio, nearly all of which are new records. The main interest of the list is that it includes Rome, Lazio representing the ancient Latium.

Italian Marine Algæ.§—A. Preda has undertaken the Marine Algæ of the "Flora Italica cryptogama," and has published the second part, consisting of the greater portion of the Florideæ. The first part, which contains the preface, introduction and bibliography, will appear shortly, together with the completion of Florideæ in page iii. The present work contains a short account of the morphology of Florideæ, followed by the systematic treatment in which keys are given to the orders, families, genera, and often to the species. Synonymy, plates and exsiccatæ are quoted, followed by a Latin diagnosis, distribution both local and general, and critical remarks. The work is illustrated by text figures, and forms a valuable addition to European marine floras.

A. Preda ‖ publishes the completion of his treatment of the Florideæ of Italy, together with a bibliography of algological literature and an introduction. In the latter he deals with the geography of the region, its seas, lakes, ponds, etc.; the biological aspect of the region; the biological features of the algæ in relation to the media in which they grow,

* Denkschr. Math. Nat. k. Akad. wiss. Wien, lxxxiv. (1908) pp. 387–400.
† Journ. of Bot., xlvii. (1909) pp. 157–64 (pl).
‡ Ann. di Bot., vii. (1909) pp. 207–11.
§ Flora Italica Cryptogama, i. fasc. 2. Rocca S. Casciano, 1908, pp. 358 (figs.).
‖ Op. cit., 1909, pp. 45, lvi., and 359–462.

and to the substrata to which they adhere; marine, lacustrine and pond floras; the flora of running water; plankton; aerial algæ; collection of algæ and phyto-biological exploration of the various aquatic media; preparation and preservation of algæ.

Japanese Algæ.*—K. Okamura publishes the tenth part of his *Icones of Japanese Algæ*, containing detailed figures of the following species:—*Gelidium subcostatum* Okam., *Ptilota pectinata* (Gunn.) Kjellm., *P. asplenioides* (Turn.) Ag., *P. californica* Rupr., *Calosiphonia vermicularis* (J. Ag.) Schm., *Ceramium Boydenii* Gepp. The text is in Japanese and English. The title-pages and index completing the first volume are included.

Physiology of Desmidiaceæ.†—A. Andreesen describes his experiments in cultivating singly the commonest forms of desmids, with a view to testing their behaviour in certain nutritive solutions, and to bring about cell-division. The various organic and inorganic compounds employed are described, and interesting results were obtained. The author summarises his results as follows:—1. Division of Desmidiaceæ is specially induced by amide compounds of nitrogen. 2. Normal conditions of air-pressure and light are indispensable for division, even with organic nutrition. 3. Certain forms, such as *Closterium moniliferum*, show themselves to be entirely adapted to organic nutrition. 4. A generation in the Desmidiaceæ lasts 48 hours under favourable conditions. 5. Plasmolysed cells form no membrane; after recovery from plasmolysis the cells may form another membrane-cylinder in the ring-furrow. 6. After plasmolysis, the plasma loses permanently or temporarily the power of division, but recovers it under favourable conditions. 7. In unfavourable conditions the transverse wall fails to form in the division of *Closterium*, and hence arise abnormal cells. 8. In strongly osmotic solutions to which have been added substances which induce division, checked growths (Hemmungsbildungen) arise, and these are capable of further division. Similar results are obtained by culture in low temperatures. 9. Prolonged cultivation in organic nutritive solutions produces a granular precipitate in the cytoplasm of *Closterium* and *Cosmarium*. 10. Organic nutrition apparently cannot in the Desmidiaceæ take the place of the assimilation of carbon. 11. In unfavourable conditions the chloroplasts of *Closterium* show remarkable signs of degeneration, such as shrivelling and crumbling; the latter occurs at a special point, viz., at a third of the half-cell from the middle. Cells with shrivelled chloroplasts are still capable of division.

Two New Species of Characium.‡—F. D. Lambert describes two new species of *Characium*, *C. gracilipes* and *C. cylindricum*, which he found in Massachusetts growing on *Branchipus vernalis* in a small pool. *C. gracilipes* occurred in greatest abundance on the flat surfaces of the two sides of the abdominal appendages of *Branchipus*, and rarely on the marginal hairs for which *C. cylindricum* seems to show preference. In respect to size, both species differ greatly from all others hitherto

* Tokyo: 1909, i. No. 10, pp. 233–58 (5 pls.).
† Flora, xcix. (1909) pp. 371–413 (figs.).
‡ Rhodora, xi. (1909) pp. 65–74 (pl.).

described for the genus. *C. gracilipes* varies in length from 80–480 μ and *C. cylindricum* from 24–430 μ. Both species are described in detail and figured. They both form hosts to a fungus, which produces considerable modification in their shape.

Wittrockiella, a New Genus.*—N. Wille describes and figures a new genus of Algæ, founded on a species which he discovered growing on the ground close to the sea in Norway. The plant, which he calls *Wittrockiella paradoxa*, is distinguished by the outermost cells of the clump of filaments being of a bright golden orange colour, while the inner cells are bright green. The filaments are united into a fairly firm gelatinous mass. The cells contain one parietal, net-like chromatophore, in the meshes of which are the pyrenoids, while in the parietal protoplasm inside the chromatophore lie some fourteen nuclei. Another peculiarity of this alga is that the orange-yellow cells on the surface of the thallus put forth hairs, which may attain a considerable length. These are regarded by the author as probably organs of absorption. *W. paradoxa* possesses two kinds of reproductive organs, akinetospores and aplanospores. The former may germinate at once in one of several different ways, or they may pass through a period of rest, for which they are specially adapted by their thick wall. They are also par excellence adapted for reproducing the plant in the place in which they are formed: for they are heavy, and so surrounded by a slimy membrane that they are not easily detached from the mother-thallus. On the other hand, the aplanospores travel quite easily to considerable distances, and, having a thin membrane, are probably incapable of going through a resting stage. They are quite possibly reduced non-ciliated swarmspores. No zoosporangia nor zoospores were observed. As regards the systematic position of this alga, it is regarded by the author as forming the type of a new family of Chætophorales near Chroolepidaceæ, described as Wittrockiellaceæ.

Life-history of Trentepohlia umbrina.†—K. Meyer writes an account of *Trentepohlia umbrina*, and describes a form, which he found growing with it, bearing pedicellate zoosporangia. This the author took at first to be *T. uncinata*, but later, finding several essential points of difference, he has called it *T. pseudouncinata*. In most details, however, it so closely resembles *T. umbrina*, that he is disposed to think it may be a form of that species, and that *T. umbrina*, like *T. bisporangiata* Kar. and others, possesses two kinds of sporangia, which are probably gametangia and zoosporangia. The life-history of *T. umbrina* is described, with the condition of its growth; the author disbelieves in the parasitism of the plant.

Development of Oocystis.‡—N. Wille has made a study of *Oocystis submarina* Lagerh., and describes its life-history, thus completing our knowledge of that plant. Material of it was found in large quantities near Arendal, in Norway, in July 1907. The author describes the size and form of the cells, the chromatosphore, pyrenoids,

* Nyt Mag. Naturv., xlvii. (1909) 21 pp. (4 pls.).
† Bot. Zeit., lxvii. (1909) pp. 25–43 (2 tabs., figs. in text).
‡ Ber. Deutsch. Bot. Gesell., xxvi*a* (1909) pp 812–22 (1 pl.).

membrane, etc., and then proceeds to relate how he found, after some days, a number of flat, three-cornered cells which clearly belonged to *Tetraëdron*, intermixed with the *Oocystis*. Finding, however, that the *Tetraëdron* cells increased without any appearance of division, he examined more carefully, and discovered that they formed the resting-cells of the *Oocystis*. He describes the manner in which these arise from the original *Oocystis*, and figures their different stages. The author kept cells of the *Tetraëdron* stage all the winter under cultivation, and watched them in the following April produce new *Oocystis* cells, two arising from each *Tetraëdron* cell. The *Tetraëdron* stage arises in consequence of certain external influences which are not definitely known yet; but the author thinks it may be due to a concentration of salt in the stagnant pools where the algæ grow.

Cladophora and Monostroma.*—F. S. Collins describes four new species of *Cladophora*: two from California, and one each from Bermuda and Jamaica. The types of three of them are preserved in the author's own herbarium.

F. S. Collins publishes † also some interesting notes on *Monostroma*, in which he gives a short historical sketch of the genus, and then discusses species-limits, alluding to criticisms of his own work by Jonsson. He claims that a distinguishing character between *M. Lactuca* and *M. Grevillei* lies in the difference of their fertile fronds, as discovered by Rosenvinge. In *M. Grevillei* the membrane of the fertile portion of the frond becomes thicker and more gelatinous, the cells elongate vertically to the surface of the frond, and finally assume the palisade form characteristic of *M. fuscum*, though on a smaller scale. As the spores are discharged the membrane melts away, and there is nothing of the persistent empty tissue shown in *M. Lactuca*. Specimens of *M. Grevillei* in this condition have been distributed in Phyc. Bor.-Americ., No. 1467. Finally, a new form, *varians*, is described for *M. orbiculatum*.

Fossil Algæ.‡—A. Rothpletz writes on algæ from the Silurian strata of Gotland and Ösel. He regards the genus *Girvanella* of Nicholson as being probably allied to Codiaceæ. It occurs in the Lower Silurian, and is distinguished from the calcareous nodules of the Alpine Trias by a complete absence of differentiation in its tissues. The latter are placed by the author in a new genus, *Sphærocodium*. The genus *Solenopora* is regarded as being allied to *Lithothamnium*. The sporangia of *S. gotlandica* are cylindrical, and occur isolated in the sterile tissue, as in *Archæolithothamnium*. The Jurassic species recorded from England is excluded from *Solenopora* and placed by itself in a special genus *Solenoporella*.

Observations on Diatoms.§—L. Mangin publishes the results of some observations he has made on diatoms. His paper is divided into four sections: (1) Chemical constitution of the membrane; (2) growth of the membrane; (3) methods of coloration of the membrane; (4)

* Rhodora, xi. (1909) pp. 17–20 (1 pl.). † Tom. cit., pp. 23–6.
‡ K. Svensk. Vetensk. Akad. Handl., xliii. (1908) 25 pp., 6 tabs.
§ Ann. Sci. Nat., sér. 9, viii. (1908) pp. 177–219 (figs. in text).

application to the study of some plankton species. In the first section the author reviews the work and conclusions of other authors, and then describes his own researches on plankton. He finds that the organic part of the membrane is constituted of pectic substances, to the exclusion of cellulose and callose, a character which distinguishes diatoms from all other plants. A discussion then follows on the relation between the organic and the mineral parts of the membrane. The author finds that the valves of diatoms consist of an organic substance identical with the pectic compounds, which is combined more or less closely with silica. The siliceous skeleton thus formed is impregnated and clothed with an external structureless membrane, which often masks, at least in the plankton species, the characteristic markings, and is rapidly dissolved by reagents. This structure explains certain anomalies observed chiefly in plankton diatoms; and since pectic substances lend themselves readily to the formation of mucilage, it is easy to explain the abundance which surrounds certain individuals and colonies.

The views of other authors on the growth of the membrane are discussed and criticised.

As regards the coloration of diatoms, it is stated that the red of ruthenium and of old alum-hæmatoxylin have produced the best results. The latter must be prepared five or six months before use, or it must be treated with a certain degree of heat; otherwise it does not act satisfactorily. The best methods of staining are described for specimens in the fresh state, and specimens after destruction of the contents and dissociation of the organosiliceous substance from the membrane.

In the final section species of *Thalassiosira*, *Chætoceros*, *Bacteriastrum*, *Ditylium*, and *Leptocylindrus* are described and figured from the point of view of the membrane.

Abnormal Coloration of Epiphytic Diatoms.*—J. Comère writes of the abnormal coloration which is found in certain diatoms. In some cases this is a constant character; in others it seems to result from a decrease in the biological functions of the plants; and in others again, especially in epiphytic forms, it may be attributed to the special action of the medium and consequently to the particular conditions in which they grow. Instances are given of various species showing differently coloured endochrome. The author then describes diatom material collected by him growing in *Oscillatoria*, *Nymphæa*, and *Ulothrix*. He finds as a result of studying these epiphytic species that the modifications which arise in their coloration may possibly be attributed to a supplementary formation of green leucites due to the more nutritive nature of the medium, and this green colour predominates over and masks the usual yellow-brown. Another hypothesis is that a kind of symbiosis may exist between host and epiphyte, since the exact shade of green is always the same in both plants; and, moreover, the green colour of the epiphytic diatoms is only found when the host-plant is in full vegetation, and does not occur in diatoms which are floating free in the same surroundings.

* Nuov. Notar., xx. (1909) pp. 1–5.

Pyxilla and Allied Genera.*—A. Forti publishes the results of his study of the genus *Pyxilla* and its allies. The first chapter is devoted to a discussion of the nature and systematic characters of *Pyxilla*, the species of which form three distinct groups. These groups should in the author's opinion take the rank of distinct genera, and he gives diagnoses of each under the names of *Pyxilla* Grev., *Pterotheca* Grun., and *Pseudopyxilla* Forti. He then groups the species genealogically under their respective genera, and describes one new species of *Pyxilla* and four of *Pseudopyxilla*. Finally he discusses the morphological types *Pyxilla Johnsoniana* Grev., and *P. Caput-avis* J. Br., as well as the question of analogy with the genus *Hemiaulus* and other Biddulphioid diatoms.

New Fossil Diatom.† — A. Forti describes a new fossil diatom from the calcareous Miocene strata of Bergonzano, *Aulacodiscus miocenicus*. It belongs to the section Areolati of Rattray, and is allied to *A. apedicellatus* Rattr., though it may be distinguished at a glance from that species. It is distantly related to *A. cornutus* and other large species figured by Brun. *A. miocenicus* is here figured magnified 300 times.

New Fresh-water Phæophycea.‡—W. Arnoldi describes and figures an interesting new alga belonging to *Streblonema*, which he calls *S. longiseta*. It was found by him growing on the thallus of *Compsopogon* in a bay of the N.-Donez River in South Russia. Till now only one species of the genus has ever been recorded in fresh-water, and that is not even a generally accepted form. The present species varies according to the time of year. In the autumn it is found in the earliest stages creeping over the thallus of *Compsopogon* and filling up the grooves of its cortical layer. It bears long bristles, which consist of twenty or more cells, and reach a length of 500 μ, a considerable size compared with the general proportions of the entire plant. The growth of the thallus is apical and very irregular, depending on the course of the grooves in the host-plant. In January, February, and March the appearance of the plant had greatly changed, a number of upright filaments having arisen from the procumbent portion, and these were all surrounded by a slimy covering, which gave a grey tinge to the whole plant. By this time the procumbent filaments of *Streblonema* had penetrated into the cells of the host-plant, even so far as the centre ; but, as no organs of absorption were found on the invading filaments, the author assumes that they are not really parasitic. The structure of *S. longiseta* is described. It possesses unilocular sporangia, and, though the author thinks he observed rudiments of plurilocular sporangia, he is unable to affirm that they exist. The zoospores show certain peculiarities, which distinguish them from those of other Phæophyceæ ; these peculiarities are described, as also the germination of the zoospores. The author thinks it possible that the growths, which he took to be gametangia, may develop in the summer, at which time he was unable to make any observations.

* Nuov. Notar., xx. (1909) pp. 19–38 (2 pls.). † Tom cit., pp. 39–40 (1 fig.).
‡ Flora, xcix. (1909) pp. 465–72 (2 pl.).

Ascophyllum-galls caused by Mytilus edulis.*—F. Tobler has studied specimens of *Ascophyllum nodosum* which had air-vesicles infested with larvæ of *Mytilus edulis*, which form their shells inside and split the vesicles. The broken vesicles exhibit on the inner wall a heteroplastic formation — a kind of cortex, which arises below the normal hair-cells of the wall, being caused by irritation and favoured by illumination. Such formations do not occur in the tissues where normal growth has ceased. The occurrence of such formations in the inner tissue tends to check further development of the cortex. The growth of the animal's shell stretches and rends the tissue, and gives a clue to the direction and force of the strain. The breaking away of parts of the frond sets up a demand for a strengthening of the mechanical tissues, and this is provided for by a development of the medullary hyphæ.

Juvenile Kelps and the Recapitulation Theory.†—R. F. Griggs writes very fully on this subject, and divides his paper into two sections: 1. The development of certain kelps. 2. The recapitulation theory in relation to the kelps. In the first section the author describes in detail and gives figures of the early stages of *Renfrewia*, *Lessoniopsis*, *Egregia*, and *Hedophyllum*. Of all the kelps *Egregia* is the most specialised, and represents the highest type. In the second section the author discusses the opinions of Montgomery, His, and Morgan on the recapitulation theory, and then considers the development of the kelps in relation to the theory and to their criticism upon it. Finally the author comes to the conclusion that, taking all the evidence into consideration, we are bound to conclude that, though organisms are subject to adaptation at any stage of their life-cycles and may gradually cut out superfluous stages, yet, except as some such tendency has operated to change the heritage, the development of the individual does recapitulate the history of the race.

Sporophylls of Lessoniopsis.‡—R. F. Griggs describes the development of the sporophylls of *Lessoniopsis litoralis*. In the sterile frond the laminæ are increased in number by repeated median longitudinal splitting, which begins at the base as a perforation and extends up the midrib to the apex. Each half becomes symmetrical by growing a second wing or ala. The sporophylls, on the other hand, possess no midrib, and their origin is different. They arise as lateral outgrowths from the meristem below the base of the lamina, thus corresponding with the sporophylls of *Alaria* and *Pterygophora*. As in the latter, they are at first cylindric at the base; but as they grow they flatten into a sessile spatulate blade usually falcate, widest at apex and cuneate at base, and 3 inches long. They slowly increase to the length of the sterile laminæ and become semicircular or subcordate at base. The diverse character of the laminæ led Reinke to remove the plant from *Lessonia* and create for it the genus *Lessoniopsis*. Phylogenetically it is of interest as showing affinity to both of the principal lines of de-

* Pringsheim's Jahrb. wiss. Bot., xlvi. (1909) pp. 568–86 (1 pl. and 2 figs.).
† Amer. Naturalist, xliii. (1909) pp. 5–30, 92–106 (figs.).
‡ Ohio Naturalist, ix. (1909) pp. 437–9 (figs.).

velopment in the kelps. It resembles the Lessoniatæ in the sterile branching. And in its sporophyll-proliferations it resembles the branching of the Alariatæ. Originally reproductive in character, these proliferations in *Egregia* become floats and photosynthetic organs. *Lessoniopsis* belongs clearly to the Lessoniatæ, and is too highly developed to be regarded as the common ancestor of the two diverging lines Lessoniatæ and Alariatæ.

Danish Species of Ceramium.*—H. E. Petersen has made a close study of the species of *Ceramium* found on the Danish coasts; and, in spite of the difficulty of defining the species in view of the numerous connecting forms, he has arranged them in a systematic sequence in accordance with anatomical and external morphological characters. There are nine species, one of which, *C. Rosenvingii*, is new to science. The main factor in the key to the species is the degree to which the cortex is developed. In one group it is regularly and distinctly separated into zones, as in *C. diaphanum*; in another group it is distinctly zonate in parts only of the plant, as in *C. fruticulosum*; in the third group it forms a continuous coating over the whole plant save at the apex and on the involucral branchlets, as in *C. rubrum*. Some of the forms of this latter species are probably due to modifications of the salinity of the water. Several photographs showing the habit of the various forms are provided in the plates, and the anatomical details are figured in the text. The paper is in Danish, with a résumé in French.

Corallinaceæ of California.†—M. B. Nichols has been studying the structure of the thallus and the development of the conceptacles in some Californian species of crustaceous Corallines, and publishes the results of his researches upon the species which has been named *Melobesia amplexifrons* by Farlow (not Harv.), *Lithophyllum zostericola* f. *mediocris* and *L. mediocre* by Foslie, but which really is a *Lithothamnion* and must be called *L. mediocre* Foslie and Nicholls.

Anatomy and Classification of Corallinaceæ.‡—R. Pilger publishes a contribution to a knowledge of the Corallinaceæ. During his visit to the Berlin Aquarium at Rovigno on the Adriatic Sea he turned his attention to the calcareous algæ lately studied by Foslie and Heydrich, and then examined freshly gathered material. He gives his results. He passes under review the general conditions of growth of most of the deep-growing species, and describes the anatomy of some eight species, discusses the nature and development of the tetraspores and tetrasporangia, the development of the cystocarps, with reference to the principles of classification of the Corallinaceæ, the attempted establishment of which by Heydrich and Foslie he criticises. He figures the anatomical details of several species.

Anatomy of Lithothamnion and Lithophyllum.§—P. Lemoine publishes an interesting note on the anatomical characters which dis-

* K. Dansk. Vidensk. Selsk. Skrift, series 7, v. (1908) pp. 41–96 (7 pls. and 9 figs.).
† Univ. California Publications (Bot.) iii. (1908) pp. 341–8 (pl.).
‡ Engler's Bot. Jahrb., xli. (1908) pp. 241–69 (6 pls.).
§ Comptes Rendus, clxviii. (1909) pp. 435–8 (figs.).

tinguish *Lithothamnion* from *Lithophyllum*. These genera are as a rule the distinguished by differences in their reproductive organs, and their identity has been difficult to decide in the absence of fruit. The author finds that the anatomy of each genus is marked by the following characters: *Lithophyllum* consists of a compact tissue intersected by thick bands which separate the concentric layers of the cells of the hypothallus, and are due to the thickening of the transverse walls. This applies equally to the horizontal and to the upright forms. *Lithothamnion*, on the contrary, consists of a lax tissue composed of chains of cells like a series of necklaces. These points are shown in figures. The author intends to show later that other genera, and even species, can be determined by anatomical characters.

Cytology of Florideæ.*—The organs of reproduction in the Florideæ have been the subject of discussion by many authors, but L. Kurssanow has still new facts to add to our knowledge. He gives a review of the results of previous investigations, and summarises the opposite opinions held on one and the same point. He then passes on to describe his own work on *Helminthora divaricata* and *Nemalion lubricum*, which resulted in the following conclusions:—1. At no stage of development of the carpogonium of *Nemalion* and *Helminthora* is the trichogyne provided with its own nucleus. The carpogonium has always a single nucleus; and the trichogyne must be regarded as merely an outgrowth from the carpogonium, not as an entire cell. Thus one can trace a gradually ascending scale of development from the lower to the higher forms of Florideæ, the simpler ones having a strictly one-celled and one-nucleated female organ, while the more highly developed (including *Polysiphonia*), according to Yamanouchi, possess a two-nucleated carpogonium. In the latter class the trichogyne has its own nucleus, even though it is not cut off from the rest of the cell. 2. The spermatia of *Helminthora* and *Nemalion* have one nucleus, and in normal cases never have more. 3. *Nemalion* possesses a well-developed pyrenoid in the centre of the chromatophore. It has a very complicated structure, being composed of the central body of the surrounding zone. The pyrenoid is distinguished by a remarkable sensitiveness to external influences, swelling up easily and finally dissolving, leaving merely a vacuole in its place. 4. A similar pyrenoid exists in general in *Helminthocladia*, and probably in *Helminthora*. The central bodies and the surrounding zone are distinguishable, the latter being filled with a quantity of strongly colourable bodies, which are often rodlike and arranged radially. Schmitz's figure representing the pyrenoid as a homogeneous body is explained by the fact that his preparations were over-coloured and the small bodies in the surrounding zone were no longer to be distinguished, so that the whole structure appeared as a homogeneous ball.

Connection between Cell-nucleus and Pyrenoid.†—M. von Derschau communicates a note on the connection between the nucleus and the pyrenoids of cells in Chlorophyceæ. Lidforss has written on this

* Flora, xcix. (1909) pp. 311–36 (2 tables).
† Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 99–100.

subject, and the present writer confirms the results of that author in the main. Experiments were made on Conferveæ, the spores of which were made to germinate in Knop's nutritive solution. The pyrenoids are composed of nuclear substance, which is probably supplied to the chromatophores for the purpose of starch formation. Filamentous processes connecting the pyrenoids with all parts of the chromatophores were observed, and the impression was given of an organically connected system of pyrenoids serving physiologically for purposes of nutrition, having as its centre the cell-nucleus. Further information is promised in a later paper.

Fungi.

(By A. Lorrain Smith, F.L.S.)

Pseudo-Absidia vulgaris.*—Notes are published by A. Sartory on the biological properties of this filamentous fungus. It grows in summer on somewhat dry horse-dung, but it is easily cultivated on carrot, etc., growing most luxuriantly at a temperature of 34–35° C. Higher temperatures are hurtful or fatal. Yeast-cells are formed in agitation of the culture medium. It is not pathogenic.

Notes on Mucors.†—A. F. Blakeslee writes a series of notes for students, summing up the work done on Mucorini within the last few years. He examines the work and results obtained by Hagen, who isolated species from the air, and by Lendner, who has worked at the Mucorini of Switzerland. The cytology of the group has been studied by Gruber in *Sporodinia* and by Dangeard in *Mucor fragilis*. Wisniewski has followed the course of zygospore formation in *Zygorhynchus Moelleri*, and Dauphin has made a study of the *Mortierellæ*. Blakeslee gives notes and criticisms of the results published by these writers.

Sexual Reproduction in Endomyces Magnusii.‡—A. Guilliermond has cultivated this fungus, and describes the formation of the fruits. Ludwig, who discovered the fungus, and later, Brefeld and Dangeard, had noted anastomosis in the mycelium, but the formation of asci had not been followed. Cultures were made on carrot by Guilliermond, who was able to watch the complete growth and development. At the ends of the hyphæ were formed either a cell with dense contents, the future oogonium, or one slighter in size and with hyaline contents, the antheridial cell. The oogonial cell contains one or more nuclei and bends over; in many cases it becomes an ascus without any conjugation, a transverse division separating the more dense upper portion from the lower part of the cell which is cut off to form the pedicel. More frequently conjugation takes place with an antheridial branch at an early stage before complete differentiation of either cell has taken place. The tip of the antheridial branch is cut off by a transverse wall, fusion takes place with the oogonial cell, their contents and nuclei pass over, and the two nuclei fuse. The fused nucleus increases in size, and

* C.R. Soc. Biol. Paris, lxvi. (1909) pp. 705–6.
† Bot. Gaz., xlvii. (1909) pp. 418–23.
‡ Comptes Rendus, cxlviii. (1909) pp. 941–3.

finally divides to form spores. The author was unable to follow the stages of division, but certain appearances indicated karyokinesis. He sees in the process a true heterogamic conjugation of two different gametes.

Parasitism of Laboulbeniaceæ.*—F. Picard has made a study of these fungi, and advises the collector where and how to gather them. They are heterœcious plants, and as their propagation depends on the contact of adult plants growing often on different hosts, they frequent almost exclusively insects that congregate together. Solitary insects are thus free from the parasites. Moist atmosphere also is essential to their development.

In another paper † Picard describes a marine form parasitic on *Aepus Robini*, which lives in clefts of the rocks under shelter of *Laminariæ*. This marine *Laboulbenia* does not alter the chitinous substance: it probably lives on the waxy matter that covers the bodies of insects.

Rare Pyrenomycete.‡—C. Engelke gives a careful description with figures of *Nummularia lutea*, which is found on old alder stems. The stroma is yellowish-brown, but becomes black through the expulsion of the dark-coloured spores. Under water, the asci, paraphyses and hyphæ dissolve into a gelatinous mass, and are ejected from the perithecia along with the spores, so that in damp weather, not only the stroma, but the surrounding wood is covered with a dark gelatinous mass.

Erysiphaceæ.§—J. P. Anderson gives an account of the genera and species of this family that occur in Iowa. Each species is carefully described, and localities and host-plants are added. Note is taken of the parasite *Ampylomyces quisqualis*, that lives on all kinds of Erysiphaceæ and evidently serves to hold them in check. A host-index is published.

G. Cuboni and L. Petri ‖ report the perithecial stage of a *Sphærotheca* on peach trees. It differed specifically from *S. pannosa*, and they suggest that it may be the fruiting form of the oak mildew of which the conidial stage only is known, and which had been very prevalent in the same neighbourhood.

North American Hypocreales.¶—F. J. Seaver publishes a second study of this subject. In the present paper he discusses *Nectria Peziza*, a well-determined *Nectria*, although the type specimen is not now in existence. The plants are often crowded, but there is no true stroma, and they collapse at maturity so as to resemble a cup-fungus, hence the specific name *Peziza*. Seaver includes a number of species as synonyms under this plant, and gives diagnosis and drawings.

In another paper Seaver ** gives an account of several new or note-

* Feuille jeunes Naturalistes, xxxix. (1909) pp. 29–34 (1 pl.).

† C.R. Soc. Biol. Paris, lxv. (1908) pp. 483–6 (2 figs.). See also Bot. Centralbl., cx. (1909) pp. 336–7.

‡ Ann. Mycol., vii. (1909) pp. 176–81 (8 figs.).

§ Proc. Iowa Acad. Sci., xiv. No. 35, 33 pp. (3 pls.).

‖ Atti R. Accad. Lincei, xviii. (1909) pp. 325–6.

¶ Bot. Torrey Bot. Club, xxxvi. (1909) pp. 201–4 (1 pl.).

** Mycologia, i. (1909) pp. 19–22 (1 pl.).

worthy species of the same group. He describes two species of *Hyponectria*, and a new *Nectria semenicola* which grew on partially decayed seeds.

Hyphomycetes.*—Lindau concludes the discussion of the genus *Harpographium*, begun in the previous fascicle, and distinguished from *Graphium* by the sickle-shaped conidia. Other genera of Tuberculinieæ are dealt with in two recently-issued parts including *Tubercularia*, *Sphacelia*, etc. The *Setosa* group, represented by *Volutella* and *Periola*, are also partly described. There are many illustrations in the text, though the genera are not all accompanied by drawings.

Uredineæ.—W. Tranzschel† records the results of a series of culture experiments: *Puccinia Epilobii* was found to be identical with *P. Veratri*; the teleutospores of *P. Sonchi* produced pycnidia, and, later, uredospores; teleutospores of *P. Allii* were sown on *Allium paniculatum*, and only uredospores were developed. Several new hosts were discovered for *P. Isiacæ*.

M. Raciborski ‡ describes a considerable number of new species from Java, belonging to such different genera as *Jola*, *Uromyces*, *Uromycladium*, *Gerwasia* g. n., *Puccinia*, *Sphærophragmium*, *Endophyllum*, *Skierka*, *Hamaspora*, *Æcidium*, *Caeoma*, and *Uredo*.

L. H. Pammel § has studied the different forms of *Gymnosporangium* that are to be found in Iowa. One of the most troublesome and destructive species is the cedar apple, *G. macropus*, which grows on red cedar, the *Roestelia* stage occurring on cultivated apples and doing great damage. He recommends the removal of cedar trees.

Réné Probst ‖ has made a series of cultures with *Puccinia Hieracii* within the genus *Hieracium*. He claims to have isolated thirteen biological species. He determined two different species from the position of the germinating pore, *Puccinia Hieracii* and *P. piloselloidarum*, these species being again split up into a number of biological form species. Details are given of the different cultures, and the occurrence of these two species with their biological forms is discussed.

T. Vestergren ¶ received from British Columbia an *Æcidium* on *Habenaria gracilis*, and found it to be identical with *Æ. alascanum* collected on several species of *Habenaria* in Alaska. It differed in several particulars from *Æ. orchidearum*.

H. Yamada and J. Miyake ** describe a new species of *Gymnosporangium* on *Chamæcyparis pisifera*. By culture experiments they proved its affinity with the *Æcidium* on *Pirus Miyabei* and *P. Aria* var. *Ramaonensis*.

* Rabenhorst's Kryptogamen-Flora, i. 9te Abt., Lief. 111–12 (Leipzig, 1909) pp. 369–496.

† Ann. Mycol., vii. (1909) p. 182.

‡ Bull. Int. Acad. Sci. Cracovie, 1909, pp. 266–80.

§ Exp. St. Iowa St. Coll., Bull. 84 (1905) 36 pp. (11 figs.).

‖ Centralbl. Bakt., xxii. (1909) p. 676–720.

¶ Svensk. Bot. Tidsk., ii. (1908) No. 1, 3 pp. See also Ann. Mycol., vii. (1909, p. 196.

** Bot. Mag. Tokio, xxii. (1908) pp. 21–8. See also Ann. Mycol., vii. (1909) p. 196.

T. Eriksson * has made a new series of experiments with crown rust, *Puccinia coronata* and *P. coronifera*. In the latter species (related to *Æcidium catharticæ*) he has traced eight form species on different grasses. In *P. coronata* (*Æcidium Frangulæ*) he determined three form species. His results agree with those of Klebahn, but not entirely with Carleton's. The form species seem to be less sharply defined in North America.

Culture experiments have been made by O. Juel † with *Uromyces Poæ*. He has determined nine forms, growing on different grasses and species of *Ranunculus*.

B. Ivanoff ‡ has studied at Berne and on the Faulhorn the different effects of temperature, etc., on the development of Uredineæ. The period of incubation depends on external conditions to a considerable extent, growth being more rapid in the sunlight than in the shade. In the cold of the mountains, or in chambers filled with ice at Berne, uredospores and teleutospores developed simultaneously. The peridial cells of *P. graminis* on *Berberis* varied in size according to their exposure to sun or shade.

Conditions of Sclerotium-formation in Botrytis cinerea.§—W. Reidemeister grew this fungus on a series of culture media with varying salt constituents and under varying conditions of light, moisture, etc. He found that sclerotia were formed in all conditions that were favourable to the growth of the mycelium. They reached a size of 5–8 mm. in diameter, and the numbers formed depended on the amount of nourishment supplied. There was considerable variety in the location of the sclerotia: thus on potassium-nitrate-dextrose-agar, they were scattered over the substratum, and on plum-juice-agar they were formed in regular rings, the latter condition being less favourable to their development. The formation of sclerotia in any of the media could be brought about by introducing some foreign body which obstructed the onward growth of the mycelium. At that point sclerotia were formed. If narcotics were introduced into the atmosphere of the culture, sclerotia were encouraged. Or, again, if the mycelium were allowed to grow over alternate layers of thicker and thinner nutriment, sclerotia were formed on the thin layers. Experiments were also made on conidial formation, it being most abundant where transpiration was most active. Where conidia were abundantly produced, sclerotia formation lagged behind. Appressoria were developed under conditions favourable to the growth of sclerotia. Tables are given representing the culture media with the percentages of salts, etc., and the corresponding developments of sclerotia and conidia.

Xylaria polymorpha.‖—F. Guéguen records his experience in the culture of this fungus. Cooked carrot was found to be the best

* Ark. Bot., viii. (1908) No. 3. See also Ann. Mycol., vii. (1909) p. 197.

† Svensk. Bot. Tidskr. ii. (1908) pp. 169–74. See also Ann. Mycol., vii. (1909) p. 197.

‡ Perioditchesko spissanié, lxviii. (1908). See also Bot. Centralbl., cx. (1909) pp. 335–6.

§ Ann. Mycol., vii. (1909), pp. 19–44 (3 figs.).

‖ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 124–5.

culture medium, and by sowing conidia from the fructifications of *Xylaria* "clubs" he obtained a white coating of mycelium which spread in concentric zones, while underneath was formed a black stroma. Later, numerous "clubs" of the *Xylaria* were formed, all of them fertile.

Torula in Beer-brewing.*—Schiönning has isolated this fungus from English lager-beer, where it occurs in great abundance. *Torula* yeasts have the power to renew fermentation in beer that has been already fermented with *Saccharomyces*, and, by the production of acids, etc., give the particular taste and odour to English beer. The author gives a series of comparisons between the different *Torula* yeasts.

L. T. Thorne † gave an abstract and criticism of Schiönning's paper before the Institute of Brewing. He agreed with the former author as to the secondary fermentation taking place, which gives the characteristic flavour to the beer.

Yeast of Rum Fermentation.‡—K. Saito describes the process followed in making an alcoholic drink from cane-sugar molasses by the inhabitants of Bonin Island (Japan). A watered solution of the molasses is allowed to stand in a warm room for a few days, when fermentation begins, and gradually it becomes covered over with a white skin formed of yeast-cells. Saito gives an analysis of the fermented liquor and an account of his culture of the yeast. He finds that it belongs to the genus *Pichia*, and is most nearly allied to *P. californica*, which was found in Californian red wine.

Mycological Notes.§—Fr. von Höhnel has been visiting Java, and now publishes notes on various fungi he has observed there. He confirms many of Petch's observations on Ceylon fungi, and for the fungus of ants' nests, gives a long series of synonyms. He describes as new genera, *Æruginospora* with blue-green spores (otherwise similar to *Clitocybe*, *Camarophyllus*, or *Cantharellus*), and *Eleutheromycella*, which grew on old pilei of *Polystictus versicolor*.

Von Hohnel ‖ spent the months of August and September in the Austrian Alps, and studied the larger Alpine fungi. A list of these is published, with notes. Several rare and interesting forms were found.

Biology of Polystictus versicolor.¶—J. S. Bayliss cultivated this fungus from spores, and followed the developments throughout. The first germination of the spores resulted in *oidium* formation ; after some four months the fungal hyphæ appeared ; the pileus was only formed when the cultures were taken to the open and placed on branches, etc. They grew best in a warm damp atmosphere, and the changes in tem-

* Woch. Brau, xxv. (1908) pp. 693-6, 710-11, 718-21, 753-4, 771-4. See also Ann. Mycol., vii. (1908) pp. 87-8.
† Journ. Inst. Brewing, xv. (1909) pp. 1-28.
‡ Centralbl. Bakt., xxi. (1908) pp. 675-7 (2 figs.).
§ SB. k. Akad. wiss. Wien Math.-Nat. Kl., cxviii. (1908) pp. 985-1032 (4 pls.).
‖ Oesterr. Bot. Zeitschr., lix., (1909) pp. 60-6, 108-12. See also Ann. Mycol., vii. (1909) p. 193.
¶ Journ. Econ. Biol., iii. (1908) pp. 1-22 (2 pls.). See also Ann. Mycol., vii. (1909) pp. 204-5.

perature caused the formation of zones in the pileus. Colour and pore formation depended greatly on light; no pores were developed in the dark.

Saccharomyces in Saké.*—R. Nakazawa has described in great detail two yeast-forms that he isolated from fermenting saké, and subjected to a series of culture tests. These two yeasts, which he has named *Saccharomyces Tokyo* and *S. yedo*, differ chiefly in the way they form giant colonies on wort-gelatin. Spore-form was the same in both, but with a slight difference in size.

Wood-destroying Fungi.†—J. Schorstein has followed in general the process of wood-destruction by fungi, and has also described some of the more important species. He challenges the correctness of Falck's determination of *Merulius* species. He adds a table of the more important wood destroyers, with the size and colour of the spores, as well as the particular habitat of each, as verified by his own and Bresadola's researches.

Edible Fungi.‡—A description is published of *Lepiota procera*, the Parasol Mushroom, one of the most abundant and generally distributed of edible fungi. It grows in open glades in woods, on heaps of leaves, etc. It is recommended as the most dainty of our edible species.

Fungi of Southern France.§—J. Lagarde has made an ecological study of the fungi at Aigoual in Lozère. He divides the territory into four districts:—1. The bottom of the valleys and along the water-courses on cultivated land, where he finds *Lepiota procera*, *Marasmius oreades*, *Coprinus comatus*, etc., etc. 2. Woods of chestnut and oak, which cover the mountain up to a height of 1050 metres; there, in addition to some of those noted, are various species of *Amanita*, *Tricholoma*, *Lactarius*, *Russula*, *Boletus*, *Polyporus*, etc., that grow more particularly on humus or on wood. 3. Above the chestnut zone of trees there are pine woods with a somewhat different flora, and, in particular, a number of different species of *Boleti*. 4. Beech woods, which grow higher up the mountain than the chestnut zone, and thus secure the maximum of moisture. Cryptogams are abundant in these forests; ferns, mosses and lichens form a large part of the soil growth, and large numbers and varieties of fungi are also found on the ground or on wood. Further notes are given as to habitat, and a list of all the fungi found at Aigoual.

Underground Fungi in Russia.‖ — Fedor Bucholtz publishes a second contribution on this subject. He describes the circumstances under which many of his collections were made and the localities where the fungi were found. The number recorded for Russia previously was 24 species and 3 varieties; by his researches he has increased that

* Centralbl. Bakt., xxii. (1909) pp. 529–40 (8 figs.).
† Zeitschr. Ing. Arch. Ver., 1908, Nos. 45–6 (fig.). See also Hedwigia, xlviii. (1909) Beibl., pp. 107–8.
‡ Journ. Board. Agric., xv. (1909) p. 839 (1 col. pl.).
§ Bull. Soc. Mycol. France, xxiv. (1908) pp. 197–220.
‖ Bull. Soc. Imp. Nat., 1907, No. 4 (1908) pp. 431–92.

number to 49 species and 14 varieties. He describes all of these and gives tables to aid in their determination. Bucholtz also adds biological observations and notes made from his large experience of these fungi. Three species (*Elaphomyces*, *Hymenogaster* and *Tuber*) have been definitely associated with mycorhiza formation, and are to be found associated with special trees. Most of the forms grow in old woodlands and old park lands. Many grow in loose humus, where moisture and circulation of air are assured to them. Shade and moisture are essential to nearly all of them. A few are developed in June and July, but autumn is the best time for collecting.

Luxemburg Fungi.*—Johann Feltgen, who issued the first part of the fungus-flora of Luxemburg, died in 1904, and the editing of the second part, comprising the Basidiomycetes and Auricularei, has been undertaken by Ernst Feltgen, the material having been collected and almost made ready for publication. The species found in the district number 870 and are arranged under 115 genera. He divides the order Basidiomycetes into the sub-orders Gasteromycetes, Phalloidei, Dacryomycetes and Tremellinei. The order Auriculariei is represented by two genera, *Auricularia* and *Platygloea*. An index of the genera is given. E. Klein adds an obituary notice of the deceased mycologist.

German Fungus Flora.†—W. Migula has issued three more fascicles of this work, dealing largely with the Chytridineæ, with the families Oochytriaceæ, Olpidiaceæ, Synchytriaceæ, Hypochytriaceæ, and Rhizidiaceæ. Many of the fungi described are of economic importance, as parasites of the higher plants. The plates issued are some of them coloured; they do not all correspond with the fascicles with which they are published.

Italian Flora.‡—Three fascicles of this flora have recently been issued dealing with Fungi. The Uredineæ are under the charge of Alex. Trotter, who begins by a general discussion of the group. The descriptive portions of the work are confined to the genera *Uromyces* and *Puccinia*, the latter only in part.

L. Petri § is the author of the Gasterales, a group well represented in Italy; here also the systematic portion of the work is preceded by a description of the different families, notes on distribution, utility, locality, habitat, etc. A full bibliography is also given.

Hymenomycetes.||—Maurice Barbier reviews the work on *Russula* published by Peltereau in a previous issue of the Journal. He finds after many years of study that many *Russulæ* regarded as distinct are only variations of one species, and also that the taste of these fungi varies with the locality; thus *R. sanguinea* is acrid in Central France and scarcely acrid in the mountains. He concludes that there are probably only about 15 really good species of *Russula*; he deprecates

* Luxemburg: P. Worré Mertens, 228 pp.

† Flora von Deutschland. Gera: F. v. Zezschwitz, 1909, Lief. 70–2, pp. 81 128 (14 pls.).

‡ Flora Ital. Crypt., i. fasc. 4 (1908) pp. 1–44 (57 figs.).

§ Op. cit., fasc. 5 (1909) 139 pp. (83 figs.).

|| Bull. Soc. Mycol. France, xxix. (1908) pp. 230–45.

the making of species or even varieties on unstable characters, such as colour, odour, taste, etc. A criticism is also given of the paper on *Russula* by F. Bataille, from whom he differs considerably in his conceptions of species, etc.

Ambrosia-Fungus.—While investigating cases of gummosis in young and old trees of *Acacia decurrens* at Amani in East Africa, A. Zimmerman* found that channels had been bored in the branches by beetles belonging to those known as Ambrosia-beetles (*Xyleborus*). Exudations of gum were found at the openings of these channels, and on closer investigation a fungus was frequently found growing in them. This was finally identified with the Ambrosia-fungus which is used by the beetles as food for the larvæ. Zimmerman found that the fungus does considerable harm to the trees, as having once gained entrance, it pierces the woody tissues and destroys them. The author gives a full account of the gum formation, and of the injury caused to the tree.

F. W. Neger † has studied the galls of *Asphondylia*, a genus of *Cecidomyia* insects that form galls on various plants. The interior of the galls has been found to be coated with a fungus similar in development to the Ambrosia-fungus. Neger had already proved that the Ambrosia-fungus of the wood-beetle was one of the Sphæriaceæ (*Ceratostomella*); he now finds that the fungus of *Asphondylia* galls belongs to the genus *Macrophoma*, one of the Sphæropsideæ. Neger gives a list of the plants on which these galls have been found. It has not been proved that all of them contain the fungus, though a great number certainly do. The fungus does no harm to the gall, and is necessary, or at least very advantageous, to the nourishment of the larva. Neger found on the empty galls pycnidia of a *Macrophoma* which grew on no other part of the plant. Probably the mother places the fungus along with the egg, and the former grows readily in the gall structure—it forms haustoria, by which it pierces the plant-tissues.

Fungus Diseases of Scale Insects and White Fly.—R. H. Rolfs and H. S. Fawcett ‡ recommend the inoculation of insects by fungi as an aid in checking their ravages. In Florida, where the experiment was tried, the climatic conditions are favourable to fungus growth, and it was found sufficient for infection purposes to tie sticks bearing the fungi in contact with the twig infected with the insects. The spores are washed about over the surface of the plant, and gain entrance to the insects. There are several different fungi that attack these insects, and destroy them without affecting the plants. The paper is illustrated by photographs and drawings of the fungi in different stages of development.

A paper § dealing with the same subject has been published by Howard S. Fawcett. In connection with work on *Citrus* diseases he studied the fungi that were parasitic on the scale insect, *Alcyrodes Citri*. He determined six different kinds of fungi on the insect itself, some of

* Centralbl. Bakt., xx. (1908) pp. 716–25 (7 figs.).
† Ber. Deutsch. Bot. Gesell., xxvi*a* (1909) pp. 735–54 (1 pl. and 2 figs.).
§ Florida Agric. Exp. Stat. Bull., xciv. (1908) 17 pp. (21 figs.).
‡ State Univ. Florida, 1908, 41 pp. (7 pls. and 19 figs.).

them, especially species of *Aschersonia*, being very widely distributed and of considerable economic importance in combating insect pests in districts where the proper conditions of temperature and moisture are present. Cultures were made of the fungi, and their life-histories studied ; the larvæ of *Alcyrodes* were successfully infected from cultures. In addition to the destruction wrought by the insects, much harm is done to the *Citrus* trees by the fungus *Meliola*, a sooty mould that lives on their sugary excretions ; it smothers the leaves of the plants by a felt of black mycelium. If the insects are killed this fungus also disappears.

Destruction of Harmful Insects by Fungi.*—J. Camara Pestana found a parasitic insect (*Lecanium hesperidum*) inhabiting an ornamental plant (*Muklenbeckia plateclata*), which had already been attacked and destroyed by a fungus. The parasite of the insect proved on examination to be *Sporotrichum globuliferum*, discovered first by Spegazzini in California on some *Coleoptera*, and since then detected on other insects, a list of which is given. The fungus never attacks the plant. Pestana describes the methods of culture and insect-inoculation which he recommends as a means of checking their multiplication.

Parasitism of Fungi.†—E. W. Schmidt has attacked the problem of chemotropic attraction in the host-plant inducing growth in the parasite. He tested the power of the hyphæ to bore through various membranes, such as celloidin, influenced by chemotropic substances. This he proved satisfactorily, but he demonstrates that the germinating spore must by enzymatic, toxic or mechanical action, alter the structure of the epidermis and cells, in order to set free a diffusion-stream which acts as a directing agent on the forward growth of the fungus.

Fungi of Seeds.‡—Franz Muth has classified the fungi that attack germinating seeds in testing beds, and finds that those of most frequent occurrence are *Rhizopus nigricans* and *Cephalothecium roseum*, which came from the surrounding atmosphere ; the parasitic fungi, as for instance *Phoma Betæ*, *Ascochyta Pisi*, *Fusarium vasinfectum*, are also found on the seeds ; other fungi are due to special circumstances affecting the seed-bed, etc., and certain bacilli are present in the water used for keeping the seeds moist. The author discusses the significance of these fungi for germinating seeds.

Edible Mushrooms.§—W. A. Murrill writes more particularly of those that grow in Bronx Park, New York, but most of the species that are exceptionally valuable for their culinary properties are described by him. He warns collectors very carefully against the deadly *Amanita*, which has neither a bad taste nor offensive smell to indicate its poisonous qualities. Special attention is drawn to the wholesome nature of puff-balls when young. He advises beginners to confine themselves at first to the common mushroom, the beef-steak fungus, the puff-balls, the coral mushrooms, and other readily recognisable forms.

* Bull. Soc. Port. Sci. Nat., ii. (1908) pp. 14–18 (1 pl.).
† Zeitschr. Pflanzenkr., xix. (1909) pp. 129–43 (7 figs.).
‡ Jahresber. Ver. Ang. Bot., v. (1908) p. 49. See also Ann. Mycol., vii. (1909) pp. 206–8.
§ Journ. New York Bot. Gard. ix. (1908) pp. 205–13 (2 pls.).

Fungi found in Butter.*—Weigmann and A. Wolff have examined butter that tasted of turnips, and have isolated several fungi, notably *Penicillium brevicaule.* The other forms were less easily determined, but one or other was akin to *Monilia*, *Mycoderma*, *Oidium*, etc. The authors of the paper made many cultures on various substrata, testing the habits of growth and also isolating the substances formed by these fungi.

Changes Effected by Filamentous Fungi on the Media in which they are Grown.†—It has been generally remarked that considerable changes are effected in culture media during and by the growth of bacteria, fungi, etc. The changes so produced may be favourable or unfavourable to further growth of the organisms, and also the substances thus formed can be destroyed by heat. Otto Lutz has examined these hypothetic products in reference to their influence on germination and on the further development of the fungi. He explains his methods of work, and gives a list of the fungi selected for experiment. He found that *Mucor Mucedo* and *Rhizopus nigricans* were the most serviceable, as they were extremely sensitive to change. A long series of experiments is given, with detailed results in each case, and in the final summing up the author states that in the most varied substrata substances are formed which hinder further growth of the fungi. It has been impossible to determine the chemical nature of these substances, or to decide if one or more were concerned as deterrents. They resemble enzymatic bodies in being sensitive to high temperatures, which destroy or lessen their activity. They are also rendered inactive by high dilution, and are destroyed by light, especially the violet rays. In cultures carried out in the light, substances were formed that encouraged growth; these were also destroyed by high temperatures.

Plant Diseases.‡—A disease attacking gooseberry bushes called the collar-fungus, due to *Cytosporina Ribis*, has been reported to the Board of Agriculture from Huntingdonshire, Cambridge, Hereford, and Kent. The fungus was first detected in Holland by Van Hall. The bushes are attacked immediately above the ground, where the bark is killed. The fungus is imbedded in the bark as small black bodies. Sometimes the larger roots are attacked. In other cases a branch is attacked, and the fungus spreads until the tree is killed. It is evidently a wound fungus, as it occurs somewhat irregularly among the bushes, though a grower in Kent stated that bushes planted in a certain circumscribed area in his garden were always killed, while those near by remained healthy.

Attention is also directed § to the serious nature of the gooseberry mildew. Instruction is given by the Board of Agriculture as to the recognition of the disease; the precautions to be observed by gooseberry growers; and as to the treatment of infected bushes. Disease may appear any time between May and November, and growers should keep liver of sulphur at hand for spraying purposes. Affected berries or shoots should be destroyed as soon as noticed.

* Centralbl. Bakt., xxii. (1909) pp. 657–71 (6 pls.).
† Ann. Mycol., vii. (1909) pp. 91–133.
‡ Journ. Board Agric., xxi. (1909) pp. 34–5. § Tom. cit., pp. 117–25.

A note is also published* in the same journal on dry scab of potatoes, called by Frank *Phellomyces sclerotiophorus*, but now known as *Spondylocladium atrovirens* Harz. The disease attacks the tubers only. It has been reported from Ireland and from the Isle of Ely.

A disease of figs† which causes spots on unripe figs and leads to decay of the fruit, has been giving trouble in North Carolina. A tree attacked with the disease may lose all its fruit. The fungus causing the disease has been examined by F. L. Stevens and J. G. Hall, who have made a series of inoculation experiments, and have concluded that it is new to science. They have named it *Colletotrichum Carica*. It grows only in somewhat damp localities.

Knischewsky‡ gives a general résumé of tropical plant diseases and their causes. He recommends the mixing of kolophonium and potato starch with Bordeaux mixture for spraying cocoa trees that have been attacked by *Phytophthora*. Cocoa trees suffer also from witches' brooms due to *Exoascus Bussei*. Cutting down and burning of the brooms is the only remedy. Cocoa canker due to *Nectria*, a wound parasite is also to be dealt with by cutting away diseased parts and closing the cut part with tar. An account is also given of diseases caused by insects.

Karl Müller§ records the outbreak of two epidemic mildews in Baden: the gooseberry mildew, *Spærotheca mors-uvæ*, and the mildew of oak leaves, as elsewhere, only the conidial form. There is not sufficient explanation as to how these two epidemics arose in that part of the country.

F. Laibach‖ describes several fungi that do harm to cultivated strawberries, *Marsonia Potentillæ*, *Leptothyrium macrothecium*, and a new species *Zythia Fragariæ*.

O. Appel and F. Laibach¶ notify a severe outbreak of disease of salad plants due to *Marssonia Panattoniana*. The leaves become brown and then decay, and the whole plant is soon destroyed.

W. Busse and P. Ulrich** experimented with seeds of Beet to determine the presence of certain fungi in the soil or in the seeds. As a result, they found that while *Phoma Betæ* was associated with the seeds; *Pythium* and *Aphanomyces* were soil fungi. They concluded that the healthiness of the seed could not be decided by the number of diseased seedlings.

F. C. von Faber†† writes on canker and witches' brooms on cocoa palms in the Cameroons. The form due to *Nectria* attacks both stems and fruit: the latter caused by *Taphrina Bussei* sp. n., attacks the buds. It has not as yet done serious damage, but ought to be kept in check.

K. Friedrichs‡‡ has proved that *Phalacrus coruscus* and its larvæ eat the spores of cereal rusts, which lose their germinating power on passing through the bodies of the insects.

* Journ. Board Agric., xxi. (1909) pp. 125–6.

† Zeitschr. Pflanzenkr., xix. (1909) pp. 65–8 (1 pl.).

‡ Tom. cit., pp. 74–80. § Zeitschr. Pflanzenkr., xix. (1909), pp. 143–4.

‖ Arb. k.. Biol. Aust. Land. Forstw. vi. (1908) pp. 76–80. See also Ann. Mycol., vii. (1909) p. 195.

¶ Tom. cit., pp. 28–37 (1 pl.). See also Ann. Mycol., vii. (1909) p. 198.

** Tom. cit., pp. 373–84. †† Tom. cit., pp. 395–406, 385–95.

‡‡ Tom. cit., pp. 38–52. See also Ann. Mycol., vii. (1909) p. 200.

F. Krüger * has studied the stalk disease of cereals said by Frank to be caused by *Ophiobolus herpotrichus*. After long observation and culture experiments he finds that, while *Ophiobolus* as a rule attacks wheat, rye is injured in the same manner by *Leptosphæria* ; he found several other fungi causing the same injury to the stalks.

W. Ruhland † found a destructive fungus on *Asparagus*. Only the conidial form was present, and was somewhat like *Monilia*. He names it *Moniliopsis Aderholdi* g. et sp. n.

Under the title Carnation Alternariose, F. L. Stevens and J. G. Hall ‡ describe a disease of carnations caused by the Hyphomycete, *Alternaria Dianthi* sp. n. The disease manifested itself as spots, mostly on the leaves, but sometimes on the stems, especially at the nodes. Cultures and inoculation experiments were carried out, proving conclusively the harmful nature of the fungus. The most damaging infection occurs at the leaf axils, where water collects and aids in the germination of the fungus spores.

A. Stift § reviews work recently published on beet and potato diseases caused by insects, fungi, or bacteria. He notes especially leaf-rolling, a disease described by Arnim as of immense economic danger. Stift does not think it of so much importance. The disease is said to be caused by a *Fusarium*.

FOEX, E.—**Rouilles des Céréales.** (Rusts of cereals.)
[Sketch of recent work, especially in reference to agriculture.]
Montpelier: Coulet et fils, 1908, 116 pp.
See also *Bot. Centralbl.*, cx. (1909) pp. 546–7.

FRIES, ROB. E. — **Ueber einige Gasteromyceten aus Bolivia und Argentinien.**
[A list, with descriptive notes, of 27 different species.]
Arkiv Bot., viii. (1909) No. 11, 34 pp. (4 pls.).
See also *Ann. Mycol.*, vii. (1909) p. 191.

GARD—**L. Oidium du Chêne pendant l'été et l'automne de 1908 dans le Sud-Ouest de la France.** (Mildew of the oak in south-west France in 1908.)
[The author suggests that frequent cutting of trees may predispose them to disease.] *Journ. Bot.*, xxi. (1908) pp. 253–6.
See also *Bot. Centralbl.*, cx. (1909) p. 547.

HENNINGS, P.—**Fungi paraenses iii.**
[A large number, mostly of microfungi, are listed; there is one new genus described, *Haplariopsis* (Mucedinaceæ).]
Hedwigia, xlviii. (1908) pp. 101–17.

MURRILL, W. A.—**Boletaceæ of North America.**
[A re-arrangement of the genus *Boletus*, with introduction of new genera; these are: *Boletinellus*, *Pulveroboletus*, *Boletellus*, and *Suillellus*.]
Mycologia, i. (1909) pp. 1–18 (1 col. pl.).

REHM—**Ascomycetes exs. Fasc. 43.**
[A number of new species and varieties are described. Many of the species are from Brazil.] *Ann. Mycol.*, vii. (1909) pp. 134–40.

SPEGAZZINI, C.—**Fungi aliquot paulistani.** (Fungi from São Paulo.)
[A large number of new species of microfungi are described; the new genera are *Dimerosporiella*, *Hyalotheles*, *Dimeriella*, and *Eudarluca*.]
Rev. Museo de la Plata, xv. (1908) pp. 7–48 (fig.).
See also *Hedwigia*, xlviii. (1908) Beibl., pp. 59–60.

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* Arb. k. Biol. Aust. Land. Forstw., vi. (1909) pp. 321–51.
† Tom. cit., pp. 71–6 (3 figs.).
‡ Bot. Gaz., xlvii. (1909) pp. 409–13 (3 figs.).
§ Centralbl. Bakt., xxiii. (1909) pp. 173–92.

STEWART, F. C., G. T. FRENCH, & J. K. WILSON—**Troubles of Alfalfa in New York.**
[A description of the various fungi parasitic on *Alfalfa*.]
New York Ag. Exp. Stat. Geneva, Bull. 305, 1908.
See also *Bot. Centralbl.*, cx. (1909) p. 548.

SYDOW, H. & P.—**Micromycetes Japonici.**
[Many new species are described. The new genera are *Hadronema* and *Teratosperma*, both Dematiaceæ.]
Ann. Mycol., vii. (1909) p. 168–75 (1 fig.).

THEISZEN, F.—**Xylariaceæ austro-brasilienses.**
[Species are carefully described, and notes added as to the best methods of grouping species.] *Tom. cit.*, pp. 141–67.

TURCONI, M.—**Intorna alla mycologica lombardo i.**
[An account of the fungi of Lombardy; 1970 have been recorded.]
Atti Int. Bot. Univ. Pavia, ser. 2, xii. (1908) p. 57.
See also *Hedwigia*, xlviii. (1908) Beibl., p. 60.

Lichens.

(By A. LORRAIN SMITH, F.L.S.)

Italian Lichens.* — A. Jatta is taking charge of the Section "Lichenes" in the new Italian Cryptogamic Flora, and the first fascicle is now published. It contains a copious Bibliographia of the subject, in so far as the writers touch on matters connected with Italian Lichens, an introduction, and a large number of genera and species of the series Homœolichenes.

In the introduction the author gives a general sketch of the biology of lichens, the development of thallus and fruit, the chemical products of the thallus, and the habitat and utility of these plants. He keeps to the old classification of Homœolichenes and Heterolichenes, as being both natural and practical; but he has made a number of changes in classification since the publication of the Sylloge, which are justified by advancing knowledge on the subject. The genera are illustrated by figures in the text.

Problems of Lichenology.†—Bruce Fink writes on this subject, with special reference to North America. He asks for collectors and students, and, above all, for the preparation of a reliable manual of North American lichens, and monographs of the genera. He also recommends lists to be made of Lichens, and that someone should undertake the typifying of Lichen genera. A more thorough knowledge of their morphology and an understanding of their symbionts are much to be desired.

Mycetozoa.

(By A. LORRAIN SMITH, F.L.S.)

Portuguese Myxomycetes.‡—C. Torrend publishes a list of Myxomycetes collected by himself in Portugal. He does not claim completeness for his catalogue; he rather hopes to incite others to enter what he considers a very rich field. He has found some very rare European species, seven or eight reputed American or tropical, and three new varieties of well-known forms. Torrend's list comprises 97 species.

* Flora Ital. Crypt., pt. iii. (1909) 112 pp. (37 figs.).
† Mycologia, i. (1909) pp. 28–32.
‡ Bull. Soc. Port. Sci. Nat., ii. (1908) pp. 55–73.

Schizophyta.

Schizomycetes.

Varieties of Streptotricheæ.* — W. Schurmann has studied the biological characters of six different strains of non-acid-fast, non-pathogenic *Streptothrix* organisms. Only two of these were stained by Gram's method ; they all showed true branching, but varied in thickness and in the nature of their spores. The author compares their growth and behaviour on twenty different nutrient media, and arranges his results in tabular form.

Bacillus nodulifaciens bovis.†—W. Pitt finds that this organism, which was first described by Langer, is sharply differentiated from the true typhoid *coli* group, by means of the usual culture methods ; but closely resembles paratyphoid and Gaertner organisms in producing gas in glucose broth ; in respect to its virulence and pathogenicity it behaves as a representative of the paratyphoid and Gaertner group. By its immunity reaction, agglutination, etc., it is possible to differentiate it from the *paratyphosus B* group.

Coccal Infection and Elephantiasis.‡—A. C. R. Foulerton and H. K. Whittingham have isolated *Micrococcus pyogenes albus* in pure culture on various media, from lymph obtained from the ankle of a man suffering from elephantiasis of the leg. Bacteriological examination of the blood from the arm gave negative results. The organism was compared with two cultures of *M. pyogenes albus* obtained from other sources, and found to be in every way identical. Considering the cause of this disease and its connection with this organism, the authors differentiated two groups of cases. In one group the condition develops slowly after long-continued dermatitis ; in the other the disease is an acute lymphatic engorgement from obstruction of the main lymphatics of the part, and in tropical countries is due to infection by Filaria. The authors do not attribute to the coccal infection any essential importance in the pathology of the particular case, but consider that it is a casual incident, and represents probably some residual infection after a previous attack of cutaneous lymphangitis.

Bacillus chlororaphis.§—Ph. Lasseur has isolated this organism from spring water ; it is a bacillus measuring about $1 \cdot 5\ \mu$ by $0 \cdot 5\ \mu$, with rounded ends, occurring either singly or as a diplobacillus, and rarely in chains ; old cultures show spore formation ; it is uncertain in staining by Gram's method ; when grown on appropriate solid or liquid media containing peptone, it forms green crystals at a temperature of about 25° C. ; these crystals are long needles arranged either in bundles or in rosettes ; in oxydising media they are yellow, in reducing media they are green. The green substance is insoluble in water, ether, and benzine, slightly soluble in alcohol, but fully soluble in acetone ; this solution has at first a yellow-green colour, which quickly becomes pale yellow, and from it crystallise long yellow needles ; by making the solution in the absence of oxygen and crystallising in vacuo, green

* Centralbl. Bakt., 1te Abt. Orig., xlix. (1909) p. 179.
† Tom. cit., p. 593. ‡ Tom. cit., p. 510.
§ C.R. Soc. Biol. Paris, lxvi. (1909) p. 272.

crystals are obtained. The green crystals are unstable and rapidly oxydise; the yellow crystals are stable, and on chemical analysis are found to be composed of carbon, hydrogen, oxygen, and nitrogen.

Bacillus anthracis and Cold-blooded Animals.*—B. Galli Valerio and P. Vourloud, employing cultures of *B. anthracis* kept at 18°–20° C., were unable to infect toads or other cold-blooded animals, although the same cultures remained pathogenic for guinea-pigs. The authors find that when introduced into *Bufo vulgaris* the bacilli are destroyed, as is the case with frogs and probably also with all other cold-blooded animals, by the bacteriolytic action of the body juices; the greater number of the organisms are not inclosed in the phagocytes, but remain free and exhibit bacteriolysis.

Bacillus endothrix.†—F. Guéguen makes a further communication anent this organism.‡ The pigment is feebly soluble in water; slowly dissolves in acetone, turpentine, and fatty oils, but more rapidly in acetic ether. The solution, which is of a pale straw colour, deposits a drab waxy substance, exhaling an odour similar to that of the cultures. It is decolorised by acids, and when boiled with acids the solution turns brown. It is therefore not a lipochrome. The bacillus was not pathogenic to laboratory animals, and is only feebly resistant to the action of antiseptics. Under unfavourable cultural conditions the morphological characters of the bacillus are altered; the cells become irregular, swollen, stunted.

Spirochæta flexibilis.§—K. Nägler obtained this organism from mud, which contained also *Sp. plicatilis*. The new *Spirochæta*, named on account of the flexibility and variety of its movements, is cylindrical with rounded ends, and measures from 20–70 μ. There is no undulating membrane, but a spiral fibril of periplast runs along the surface of the ectoplasm. There is some evidence that it divides longitudinally. The author has named it *S. flexibilis*, and suggests for the new genus the term *Spirophis*.

Bacillus amylobacter A.M. et Bredemann.‖—G. Bredemann makes an important contribution to bacteriology in an article on the morphological, physiological, and systematic relations of *B. amylobacter*. The communication has special reference to the assimilative power of this species for nitrogen. The author includes in his species several kinds of bacteria described by other observers, such as *Clostridium*, *Granulobacter*, and *Amylobacter*. An elaborate account of the technique is included. The communication, practically a monograph, forms the whole of the number of the Centralblatt.

Pathogenic Effects of Streptococcus fæcalis and of its Endotoxin.¶—S. Martin reports that the stability of *Streptococcus fæcalis* renders it easy of manipulation in performing experiments. It grows well and readily in ordinary media, both liquid and solid, and retains

* Centralbl. Bakt., 1te Abt. Orig., xlix. (1909) p. 514.
† Comptes Rendus, cxlviii. (1909) pp. 1632–3.
‡ See this Journal, 1908, p. 360.
§ Centralbl. Bakt. 1te Abt. Orig., l. (1909) pp. 445–7 (1 pl.).
‖ Op. cit., 2te Abt., xxiii. (1909) pp. 1–568 (6 pls. and 13 text figs.).
¶ Rep. Local Govt. Board, App. B, 1909, pp. 445–56 (8 figs.).

its cultural characters for a long time. Litmus-milk is coagulated and reddened, and fermentation changes occur in litmus-broth media containing mannite, lactose, saccharose, and salicin, while inulin and raffinose are unaffected. Passage through an animal body has no effect in altering the biological characters of the microbe. It is pathogenic to rabbits, and two out of four of these animals acquired vegetative endocarditis after infection with pure cultures. The toxic effects are the result of an endotoxin, and not of a toxin, which is excreted. The results of this investigation are obviously of great importance.

Bacillus fusiformis of Vincent.*—G. Repaci claims that he has isolated and cultivated successfully the *Bacillus fusiformis* of Vincent. The medium used was sugar-agar. The microbe is an essential anaerobe. The colonies are discoid, dirty white with sharp and regular margin. The bacillus grows easily in liquid media, forming a white sediment. It does not form indol. It acidifies milk without coagulation. It does not liquefy gelatin or attack white of egg. It does not form spores or produce gas. The cultures exhale a most disagreeable odour. Morphologically it varies in length from 6–16 μ: it is easily stained, but not by Gram's method. It is non-motile and uniformly refringent when unstained, but in fixed and stained preparations the bacilli show several granules. It is pathogenic to animals, but not markedly so, and does not reproduce the appearances seen in cases of Vincent's angina.

Sarcina mucosa.†—E. Sauerbeck found this micro-organism in sputum, and suggests that it is a new species. The growth on agar is extremely like that of Friedländer's bacillus. Microscopically the *Sarcina* is seen in packets of four and eight surrounded by a wide capsule. It does not liquefy gelatin, has no action on sugars or on milk. It is pathogenic to mice, rats, and guinea-pigs, but not to rabbits.

Hemispora stellata.‡—Gougerot and Caraven mention a fungus which caused osteomyelitis. It is classed with the *Oospora*, but no description or characters are given. It produced osteomyelitis in one rabbit when injected into the epiphysis of a bone.

Bacillus mucogenes bipolaris hominis.§—V. and A. Babes describe a bacterium which causes hæmorrhagic septicæmia. It is a rodlet from 0·5–0·6 μ long. It has a marked polar staining; the polar granules are Gram-positive. Each bacillus is surrounded by a thick capsule; on agar it grows freely, the colonies having a whitish centre; it liquefies gelatin; on potato the growth is yellow, slimy, and abundant: it does not form gas, indol, nor coagulate milk; it forms acid in saccharated liquid media, which become cloudy; it kills mice, but has no effect on guinea-pigs or rabbits.

Bertrand, G., & F. Duchacek—**Action du ferment bulgare sur les principaux sucres.** *Ann. Inst. Pasteur*, xxiii. (1909) pp. 402–14.

Bordet, J., & O. Gengou—**L'Endotoxine coquelucheuse.** *Tom. cit.*, pp. 415–19.

* C.R. Soc. Biol. Paris, lxvi. (1909) pp. 860–2.
† Centralbl. Bakt., 1te Abt. Orig., l. (1909) pp. 289–95 (3 figs.).
‡ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 474–6. § Tom. cit., pp. 477–9.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

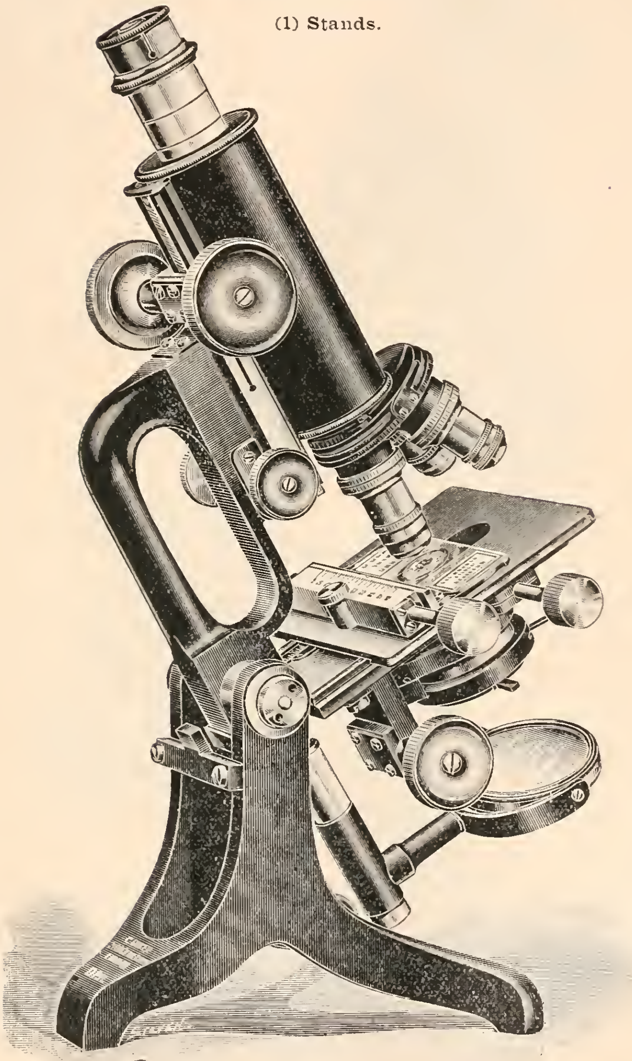

Fig. 73.

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

C. Baker's New Model D.P.H. Microscopes.*—These instruments are provided with a body-tube $1\frac{1}{2}$ in. diameter, in which slides a draw-tube carrying an eye-piece 23 2 mm. diameter. They are fitted with

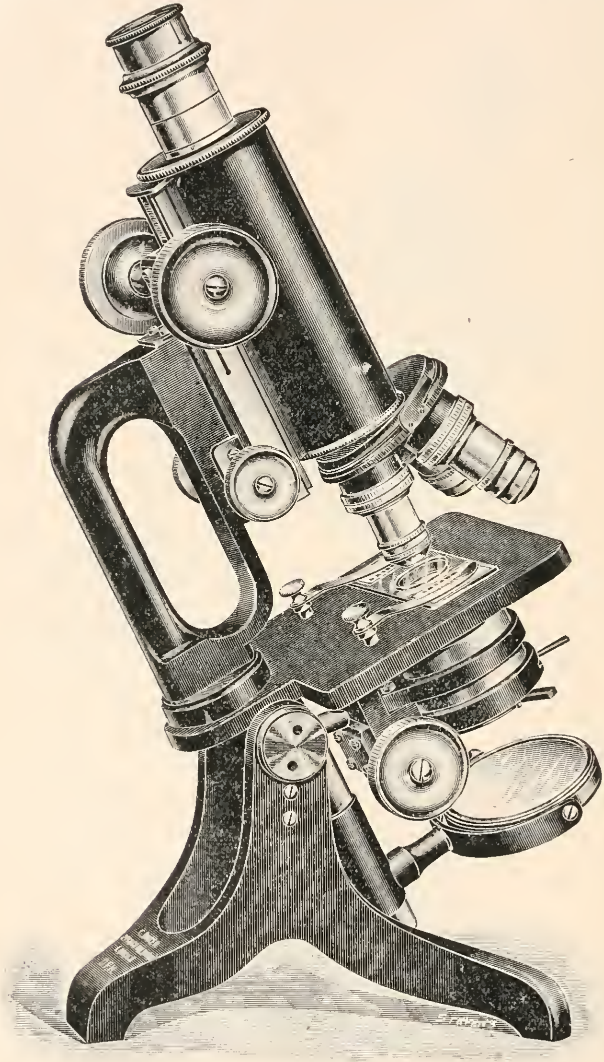

Fig. 74.

diagonal rack-and-pinion coarse-adjustment which is carried on a limb cast in one piece with an opening in which the fingers can be placed when lifting. The milled heads of the fine-adjustment are placed on

* C. Baker's Special Catalogue, 1909.

either side of the limb and actuate a lever giving a very smooth and delicate movement.

In Stand No. 1 (fig. 73) the body and limb are mounted on a stage below the trunnions, and the instrument will be found very steady when

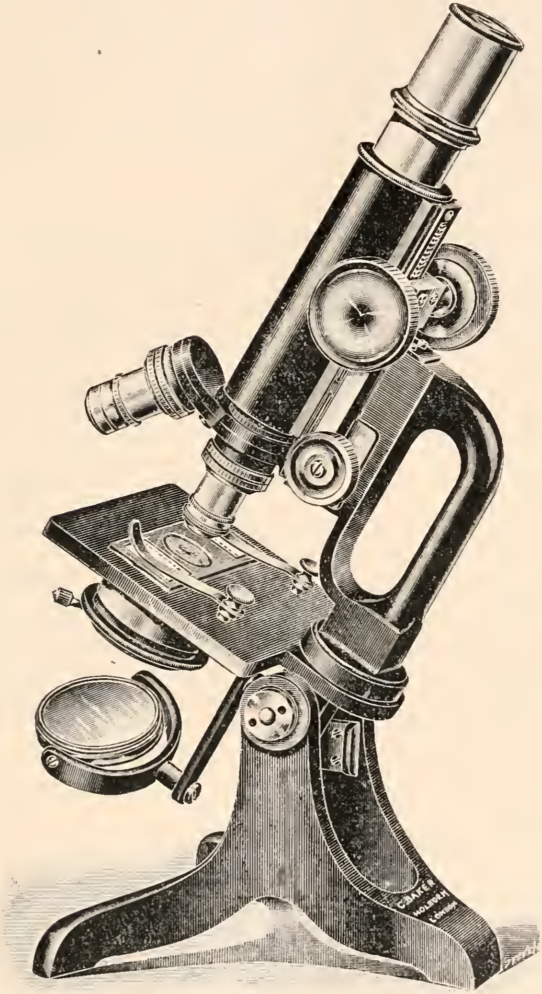

Fig. 75.

placed in the horizontal position. The mechanical stage, which is built on the Microscope and is very rigid, has a range of 25 mm. in a vertical and 60 mm. in a horizontal direction, both graduated to $\frac{1}{2}$ mm. The mechanism of the latter movement can, if desired, be removed, leaving a large square stage 3⅞ in. by 3½ in., on which large sections or the contents of a Petri dish can be examined.

Stand No. 2 (fig. 74) is similar to the above, with the exception of the stage, which is mounted above the trunnions to allow a Mayall adaptable mechanical stage being fitted. The instrument is mounted on a tripod claw foot and is provided with either a substage having diagonal rack-and-pinion or spiral screw focusing adjustment.

Plane and concave mirrors of 50 mm. diameter are supplied in gymbals, mounted on a tail-piece with universal movements.

Baker's New Model Histological Microscope.*—This instrument (fig. 75) is a smaller type of the D.P.H. No. 2, but has only one milled head actuating the fine-adjustment.

NACHET—**Microscope pour déterminer les taches de sang visibles ou invisibles, récentes ou anciennes, sur un corps opaque.**
C.R. Assoc. Anat., 10 Réun., Marseilles, 1908, pp. 201–3 (2 figs.).

GEBHARDT, W.—**Aus Optischen und Mechanischen Werkssatten ii.**
[The writer continues his review of improvements in English and foreign Microscopes.] *Zeitschr. wiss. Mikrosk.*, xxv. (1908) pp. 452–71 (10 figs.).
Note.—For the writer's first paper see *Tom. cit.*, p. 36.

(3) Illuminating and other Apparatus.

Simplified Apparatus for Drawing with the aid of the Projection Microscope.†—W. A. Riley's simple device is intended for use in the lecture room where a projection outfit stands, without duplication of

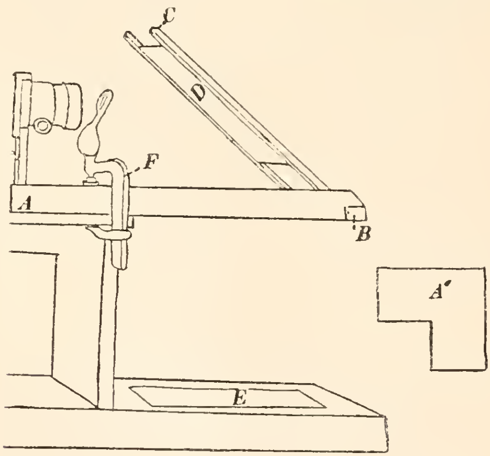

FIG. 76.

apparatus or requirement of extra space. It consists (fig. 76) of a rod holding a mirror at an angle of 45°, clamped to the stand which carries the projection lantern or the micro-projection outfit. In a darkened

* C. Baker's Special Catalogue, 1909.
† Science, xxix. (1909) pp. 37–8 (1 fig.).

room the projection of microscopic preparations, lantern slides, or of photographic negatives may be easily traced, and a glance at the illustration will show the simplicity of the construction. A, shown also in end section at A′, is a piece of wood 2 × 2 in. and about 3 ft. long, grooved by means of a rabbet plane, so as to clamp firmly to the lantern table (see A′). The arm B bears the two grooved strips C, which carry at an angle of 45° the mirror D. This casts the image on the drawing surface E, where it may be traced with ease. The magnification depends directly upon the distance of the drawing-board from the mirror. Thus if the enlargement is two times when the line E–D is 10 in., the image will be enlarged four times if the line E–D is 20 in. Magnification also depends upon the distance of the mirror from the lens.

Direct-vision Prism and Apparatus for the Projection of Spectra and for Illumination with Spectral Light.* — J. Koenigsberger describes under the above title the fluid prisms made by the firm of F. Hellige and Co., of Freiburg, Breisgau. He recommends them as superior in cheapness and efficiency to any others, and as more adapted for projection.

Illuminating Arrangement for the Metal-Microscope.†—W. v. Ignatowsky draws attention to the difficulty of effectively illuminating

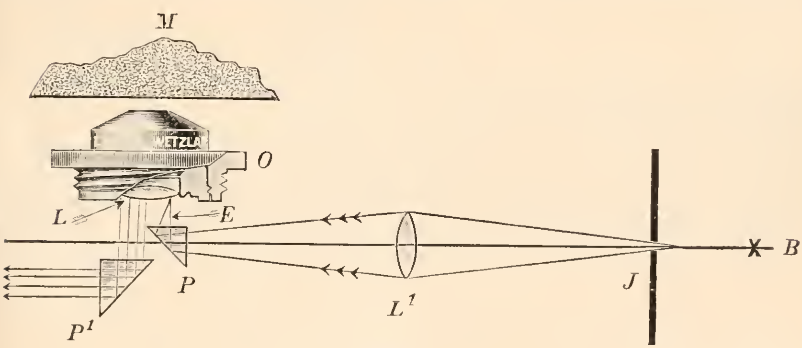

Fig. 77.

the object in high-power metallography, and points out that illumination must therefore be through the objective. Reflections at the back surfaces of the constituent lenses, however, interfere with the object, and, although these reflections can be to a certain extent cut out by a stop, the manipulation is tedious and difficult. The author suggests, therefore, the arrangement shown in fig. 77. B is the light-source; J, an iris; L_1, a small lens; M, the metal object; O, the objective; L, the back lens; and P the prism. This prism, P, is rotatory about a perpendicular axis, and can also be moved backwards and forwards along A B. The result is that, when the iris-opening is reduced, any

* Zeitschr. wiss. Mikrosk., xxv. (1909) pp. 287–8.
† Tom. cit., pp. 434–8 (3 figs.).

rays reflected at L are thrown aside and do not reach the second prism. This adjustment is described as easy and rapid.

Fig. 78 shows the complete apparatus, as built up by Messrs. Leitz, on Le Chatelier's principle. The object is simply laid on the stage T, and adjustment is performed by stage-movement, the other parts of the apparatus being unmoved. By means of the second prism P (fig. 77) the rays required for vision are switched off to the left, and the actual observation is through O and a corresponding prism. If this last prism be taken out, the photographic apparatus comes into action. A small lamp of constant current-strength (4 amperes) with hand-regulation serves as the light-source.

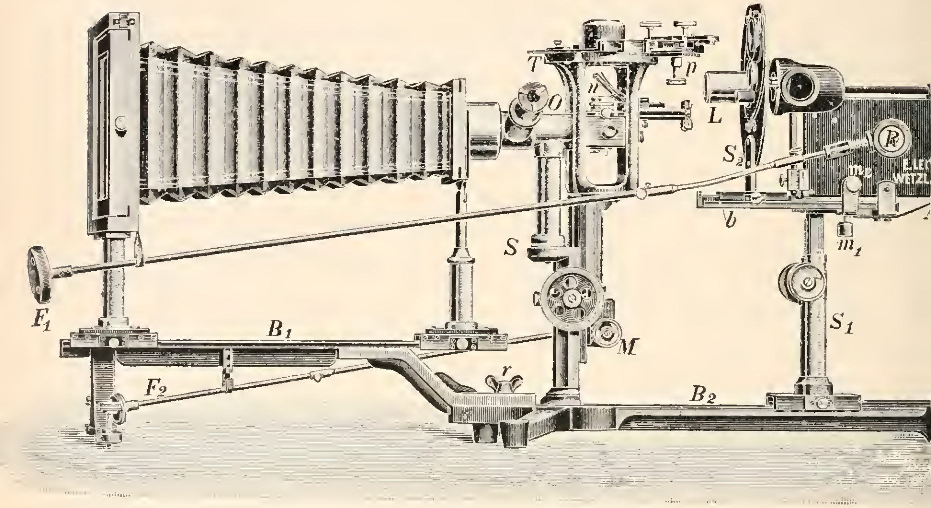

FIG. 78.

Microscopical Observations with Dark-ground Illumination.*—In this article H. Siedentopf discusses the following points connected with dark-ground work:—(1) Brightness of condenser; (2) criteria for under- and over-correction; (3) cover-glass correction due to tube-movement; (4) observations with immersion-systems; (5) advantages of dark-ground illumination with coloured preparations; (6) variations in images.

In dealing with the first head, the author describes a method of testing the brightness of a condenser by directly observing the visibility of the issuing rays. A black glass plate G (fig. 79) and a small prism A are cemented on to the underside of a cover-glass D, leaving between them a hollow space 15 mm. long, 3 mm. high, and 2–3 mm. broad. This space is to receive a fluorescing immersion fluid, cedar-

* Zeitschr. wiss. Mikrosk., xxv. (1909) pp. 273–82 (3 figs. and a plate of 9 microphotographs).

wood oil being recommended, as in arc-light it fluoresces without further treatment. This little apparatus is set centrally on the condenser P. The dark-ground condenser is then so placed on the Microscope stage that the middle of the prism A lies in the Microscope axis. Capillary attraction draws the cedar oil up into the hollow space. A narrow slit (fig. 81) is arranged under the condenser, the slit being about 2 mm. broad between the two slips of cardboard, and lying approximately centrally over the central diaphragm C. As the condensers are figures of rotation, it suffices to discover the ray-combina-

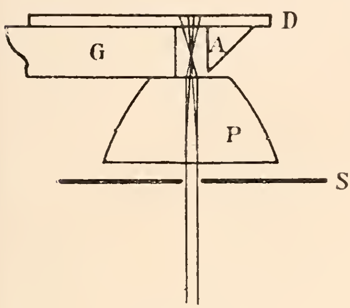

FIG. 79.

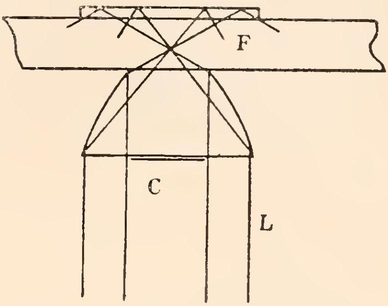

FIG. 80.

tion in a plane-section containing the axis of rotation. Such a part is stopped out by means of the slit S. When the length of the oil-chamber has been made to coincide with that of the slit, it is then possible, by help of the prism A, to observe the course of the rays directly with a loup, or with a low Microscope system. Two ray-courses are observed near the prism: one from above, one from the side. Fig. 80 gives a diagrammatic representation of these rays L, which pass outside the central stop C, and through the slip S enter the condenser approximately parallel. These come to a focus at F in the cedar-oil space, and are then totally reflected at the cover-glass. The prism A reveals these rays against the dark background of the black glass G. Arc-light must be used at a distance of 1–2 metres, and the horizontally incident rays are not reflected up the Microscope from a mirror (which usually gives two images) but from a right-angled totally reflecting prism; in one series of observations the arc-light being focused by a lens, the second series being without any such control. In the former case a larger illuminated view-field and a much more intensive dark-ground illumination were obtained. The author gives a plate of nine photomicographs showing the illumination under different circumstances. The superior brightness in the cases when an illuminating lens was used is very noticeable.

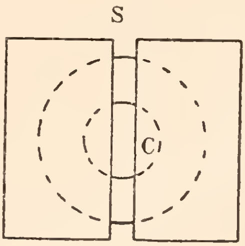

FIG. 81.

Work with the Paraboloid Condenser.*—W. Scheffer communicates, with much technical detail, an account of certain work with the Zeiss paraboloid condenser. The plate appended to his paper consists of six instantaneous photographs of various objects (spermatozoids, blood-corpuscles, etc.), some of which were photographed while in active motion.

Hensoldt and Sons' New Angle Prisms for 90°, 180°, 45°, and Roof-prism.†—The Wetzlar firm strongly recommend these prisms as being much superior to the glass mirrors frequently used in optical instruments. Their special advantages are: (1) Very large field of view; (2) absolute accuracy; (3) invariability; (4) quick orientation with regard to the object. The manner of use is to obtain coincidence of object and the image, as is often done by mirrors in instruments of older type.

Fig. 82 shows the "pentagon" prism, which is adapted for deviating

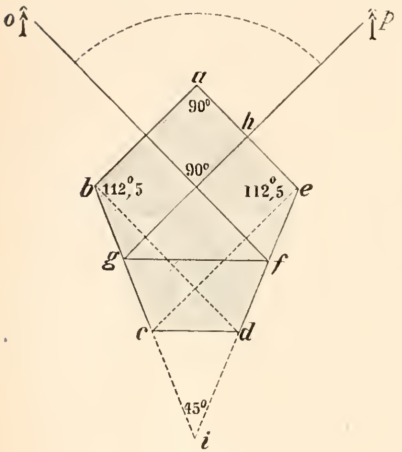

Fig. 82.

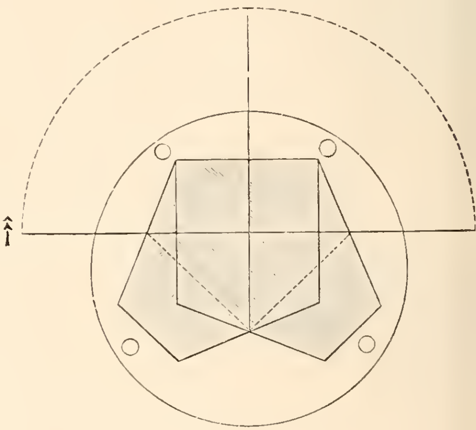

Fig. 83.

a ray through 90°. The path of the ray proceeding from *o* and falling perpendicularly on the surface *b a* is easily traced on the diagram. It will be noted that the prism is made of one piece.

Fig. 83 shows a combination of two "pentagon" prisms reversed and rotated through 90°. This arrangement gives a deviation of 180°.

Fig. 84 shows the "pentagon" prism bisected through *i* and inverted. If now the observer looks over the prism in the direction *a c* at an object *p* he will find *p* coincide with the image of *o* seen by refraction and reflection along the broken line *o g r s t*. In this way an angle of 45° was obtained.

* Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 446–50 (1 pl.).
† Catalogue, M. Hensoldt und Söhne, Wetzlar.

Fig. 85* shows the same firm's new roof-prism ("Dachprisma"). It is intended to serve the purpose of an erecting-lens in optical instruments, accomplishing the same object without loss of light. The prisms are totally reflecting, and have no cement layer.

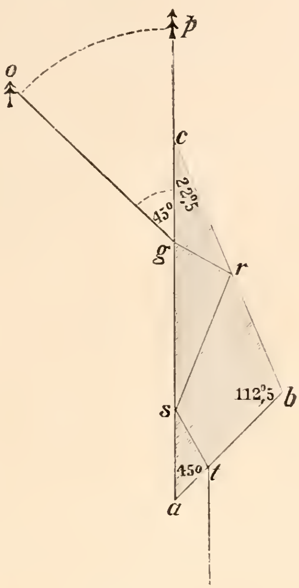

FIG. 84.

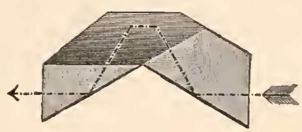

FIG. 85.

Simple Drawing and Projection Apparatus.†—W. Imboden has devised an apparatus for drawing microscopical low power objects. It

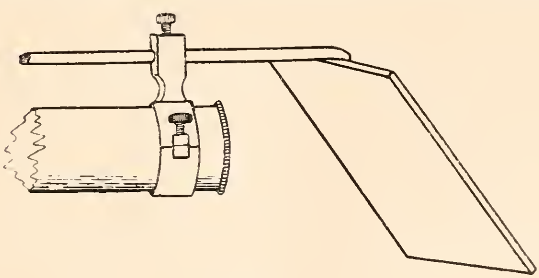

FIG. 86.

consists of: (1) a Microscope inclined to a horizontal position, fitted with a long-focus condenser, a 1-in. objective and one or two oculars; (2) a projecting mirror; (3) a light-screen; and (4) an adequate

* Catalogue, Astronomische-Optik.
† Journ. Quekett Micr. Club, x. (1909) pp. 353–6 (2 figs.).

illuminant. The projecting mirror (fig. 86), about 4 × 3 in. in size, is fixed to a metal arm, about 4½ in. long, which is connected with the draw-tube of the Microscope by means of a clamping ring. It is fixed so as to incline towards the face of the ocular at an angle of 45°, and can be adjusted for length by sliding the arm in or out.

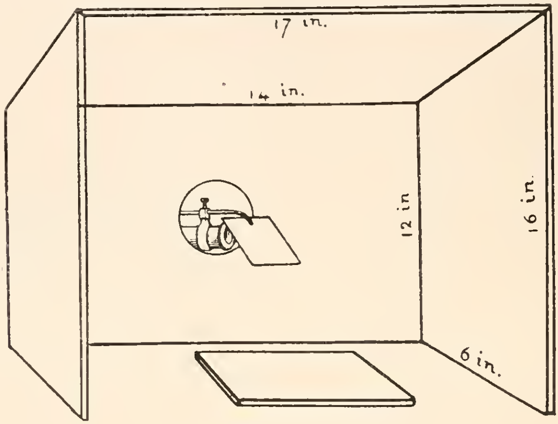

Fig. 87.

The screen (fig. 87), the shape and size of which, and also the position of the ocular and mirror, may be gathered from the illustration, is constructed of cardboard or thin wood.

(4) Photomicrography.

Resolution of Edges in Microscopical Images.*—In this article, H. Siedentopf discusses the resolution of objects which are ultramicroscopic in two dimensions only. Such objects are frequently exemplified in the case of free edges, bacteria, scratches, etc. The edges produce ultramicrons of the nature of diffraction-stripes rather than of diffraction-disks, and are best seen by dark-ground illumination. The breadth of the stripe varies as the aperture of illumination and as the wave-length. But, while with ultramicrons of approximately equal diameter the direction of light-concentration is immaterial, it is altogether another matter with edges, which are necessarily best revealed with light of a suitable inclination. Such objects are, therefore, closely dependent upon the *azimuth of illumination*. The author explains this term by supposing the Microscope tube vertical and by considering a ray which strikes the tube-axis at a certain angle. This ray and the axis are in a certain plane, and if the observer on looking down the tube imagines a clock-dial in front of him, the position of this plane can be fixed by reference to the plane containing the tube-axis and the figures xii and vi on the dial. Thus an azimuth of 90° would lie to the due right of the observer. The azimuth of an edge in a microscopical

* Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 424–31 (1 pl. and 2 figs.).

preparation can be similarly stated and the *relative azimuth* of such an edge to the illumination would be the difference of edge-azimuth and illumination-azimuth. As a good working principle, the author lays it down that considerable quantities of light are diffracted by edges and such-like objects in a direction perpendicular to themselves (i.e. in the direction of the Microscope axis) only if the illumination-azimuth is approximately perpendicular to the plane which contains the edge and the Microscope axis.

The appearance is easily studied in the back focal plane of the Microscope objective after extraction of the ocular. It is seen with both transparent and absorbent bodies and with both microscopic and ultramicroscopic edge-thicknesses. Among objects with ultramicroscopic edges must be reckoned many bacteria as well as very fine crystalline needles. These last would essentially decompose the light in the neighbourhood of an edge, which might perhaps act as a very sharp-pointed prism. In order therefore to make edges visible in the microscopical image, it is requisite that the illumination lie in relative azimuth of 90° or 270° to them. If it is desired that at any selected azimuth all edges in the object should appear in the image, then the illuminating rays must impinge at all azimuths, and all azimuths of the illuminated condenser aperture must be filled with light. But if the azimuth of illumination be limited by a slit-diaphragm (fig. 88) placed in the Abbe diaphragm holder, then in the microscopical image only those edges appear whose azimuth relative to the slit is 90° or 270°. On rotation of the slit-diaphragm a continuous alteration of the image will result, some edges disappearing and others coming into view.

Fig. 88.

The author illustrates his treatise by a plate showing the images of some plankton material from the Mediterranean. One view is due to light in all azimuths and two views of the same object to light at azimuths of 90° to each other. The views, at first sight, would seem absolutely discordant.

If the condenser is racked a little out of focus, the centre of the field appears dark and the diffraction-stripes group themselves in a merry-go-round fashion (Karusselförmig), and as the slit-disk is rotated these continually change, only those edges coming into view which are perpendicular to the azimuth of illumination. The author suggests that an application of his ideas might be of practical value in helping to bring out special detail in an object. As another illustration he shows the very different appearances presented by *Spirochæta pallida* under similar treatment.

Simple Stand for Photography of Macro- and Microscopic Objects.* H. L. Heusner has found that he can get a very useful stand out of a cylindrical iron rod of 20–25 mm. diameter and 100–150 c.cm. length. (fig. 89). The lower end fits into a heavy foot and rests upon the floor, or on a stove, and the upper end is arranged for convenient clamping to

* Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 432–3 (1 fig.).

the edge of a table. The camera slides on the rod and can be clamped in any position required. A few inches below the camera, and at a suitable distance for focusing, slides a stage intended to receive a clear glass plate, a milk-glass plate, a sheet of cardboard, or a metal plate. A hinged arm carries an incandescent lamp for illuminating the upper surface. By means of a mirror on a lower stage the lamp-light can be directed upwards on to the lower side of a transparent object. Both stages can be clamped at any desired height, they can also be easily swung out of action, and this is done for photomicrography, the Microscope being then placed on the stool, or floor, vertically under the camera.

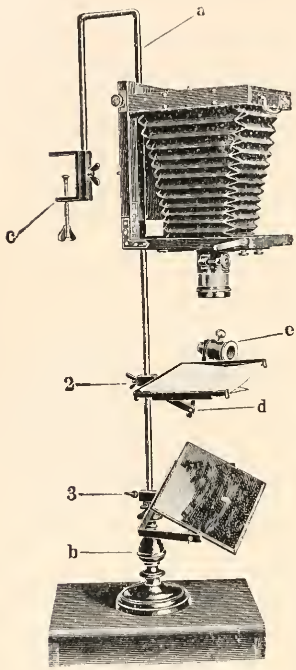

Fig. 89.

Economical Monochromatic Filters.*—J. Jullien gives the following directions for obtaining filters. Take an unexposed sensitive plate, fix it by hyposulphite, and wash it as a negative. Afterwards immerse it for some minutes in a solution of 70 p.c. alcohol, 200 cm. Mars yellow (aniline) 1 gr. Dry it out of reach of dust. This gives filters very nearly approaching the ideal yellow. Other aniline colours, after comparative trials with the spectroscope, will give by this process excellent screens of other tints; the green is, after the yellow, most frequently employed.

Kinematography of Fertilisation and Cell-division.†—J. Ries describes how he applied a kinemato-photomicrographic apparatus to record the successive changes occurring during fertilisation and cell-division. The author used (fig. 90) a Zeiss Microscope and photographic apparatus, a prism being inserted between the ocular and bellows. The correct focus was obtained by means of a mirror, revolving 45°, placed in the box intervening between the bellows and the kinematograph; the image being thrown on a round glass disk. When the egg was ripe for division, the mirror was turned, the rays from the Microscope being then directed on to the kinematograph film. The progress of division was from time to time controlled by means of the mirror. The kinematograph apparatus was the ordinary Lumière's, and was actuated by a clockwork mechanism which turned the crank seven times a minute. The illuminant, an electric metallic film lamp,

* Bull. Soc. Zool. de Genève, 1908, p. 104.
† Arch. Mikr. Anat. u. Entwickl., lxxiv. (1909) pp. 1–31 (2 pls. and 12 figs.).

is described as defective, but later the author had recourse to a special apparatus which allowed the use of sun- and arc-light, so that higher powers could be employed.

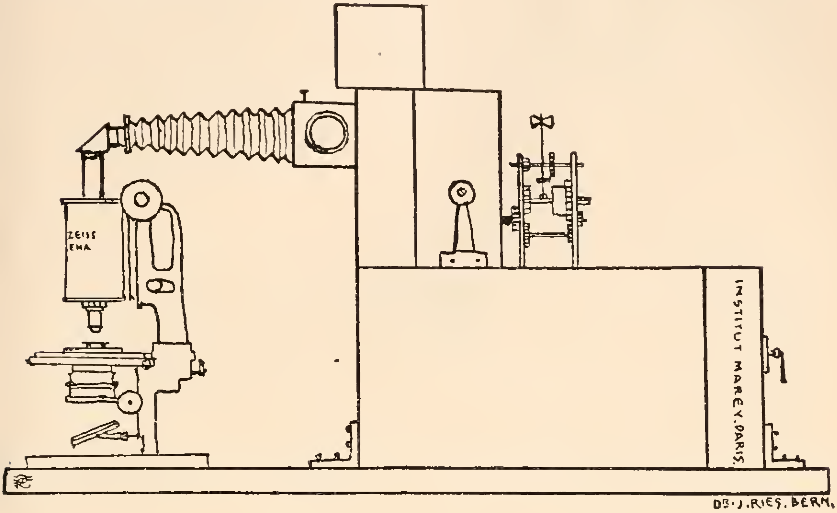

FIG. 90.

Practical Photomicrography.*—J. Jullien describes how an operator, moderately skilful with his hands, can make a framework which will give very satisfactory results at an outlay of about a couple of shillings. The bottom of a kind of box on suitable trestles is pierced for the insertion of the microscope tube, and the top is formed of a ground-glass plate. The apparatus is thus a camera of peculiar form. The light source is an incandescent gas lamp, and the author gives full practical details.

MILNE, J. R.—**A Special Form of Photographic Camera for Recording the Readings of the Scales of Scientific Instruments.**
Proc. Roy. Soc. Edinburgh, xxix. (1908–9) pp. 176–81 (4 figs.).

(5) Microscopical Optics and Manipulation.

BARNARD, T. E.—**Ultra-microscopic Vision.**
[Gives a clear account of the present state of this subject.]
Nature, lxxix. (1909) pp. 489–90 (2 figs.).

(6) Miscellaneous.

Quekett Microscopical Club.—The 458th Ordinary Meeting was held on June 4, Dr. E. J. Spitta, F.R.A.S. F.R.M.S., Vice-President, in the Chair. A specimen of *Navicula lyra* exhibiting abnormal markings, one of several found in the same gathering, sent by Mr.

* Bull. Soc. Zool. de Genève, 1908, pp. 101–4 (1 fig.).

Walter Bagshaw, was shown by Mr. C. Lees Curties, F.R.M.S. Dr. Spitta referred to the great variability of *Navicula smithii.* Mr. F. Martin Duncan, F.R.P.S., gave a lecture on "The Romance of Forest Life," with lantern illustrations.

KOCH, L.—**Die mikroskopische Analyse des Drogenpulver. Ein Atlas für Apotheker, Drogisten, und Studierende der Pharmazie.**
Berlin: Gebr. Bornträger, 1908. Vierter Band (Schlussband): Die Samen und Früchte (14 lith. Taf. u. 16 Holzschritten).

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Cultivation of Spirochæta Duttoni.†—C. M. Duval and J. L. Todd have successfully cultivated this organism on a medium which is prepared as follows:—"The yolks of two fresh hen's eggs are carefully separated from the whites under aseptic precautions and dropped into a 200 c.cm. Erlenmeyer flask, to which has been previously added 100 c.cm. of a sterile mouse decoction, made by boiling the skinned bodies of six mice in 500 c.cm. of water. This mixture is thoroughly shaken until it is homogeneous, when 5 c.cm. of defibrinated sterile mouse blood is added to it. The flask is now sealed, to prevent drying of the medium, and placed at 37° C. from six to eight weeks until the mixture undergoes partial digestion. The semi-fluid mass first becomes solidified and finally, through autolytic action, is broken down to a mush-like, grumous mass. In our experience this partial auto-digestion of the medium seems essential to the multiplication of the *Spirochætæ*. If the egg mixture is coagulated at higher temperatures it seems to be no longer suitable for the growth of the parasites." The authors formulate the following conclusions as the result of their experiments:—(1) That *Spirochæta duttoni* can be maintained virulent for white mice for forty days; (2) that it will multiply and can be successfully transferred in artificial media.

Examining Living Leucocytes in vitro.‡—C. Ponder describes a method whereby he obtains perfectly clean preparations of a great quantity of leucocytes obtained direct from any blood, the leucocytes being kept alive for quite a long time. The necessary apparatus is to be found in all pathological and physiological laboratories; the only other unusual material is modelling clay or "plasticine."

The essential point is the preparation of a blood-chamber whereby the white cells are allowed to escape from the clot and adhere to the surface of a slide or coverslip, the clot being afterwards removed. To make this chamber a morsel of plasticine, half the size of a pea, is rolled out until it is as thin as the lead of a pencil and about an inch and half long; this is then taken and gently fixed on a clean slide, so

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, etc.; (6) Miscellaneous.

† Lancet, 1909, i. pp. 834–5.

‡ Proc. Cambridge Phil. Soc., xv. (1909) pp. 30–3 (2 figs.).

as to wall in a small chamber with an entrance passage leading into it (fig. 91).

A drop of blood is allowed to fall into the chamber at *A*, a coverslip is imposed and gently pressed down with a glass slide, so that as the plasticine is flattened, blood and air are driven out of the passage *B*, which must be kept patent so that the chamber is completely filled with an even layer of blood (fig. 92).

The chamber is now incubated at about blood temperature for any length of time, from ten minutes to three or four hours, according to requirements. The whole slide in which the chamber has been prepared is immersed in a dish of normal (75 p.c.) saline. During

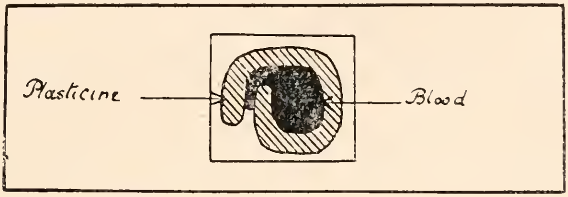

FIG. 91.

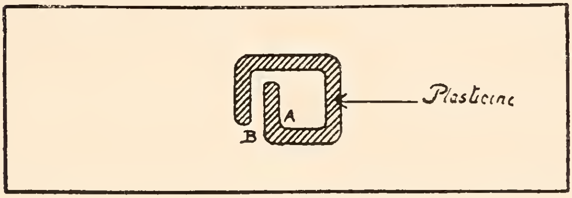

FIG. 92.

incubation the blood clots, the leucocytes escape and adhere firmly in hundreds to the surface of the slide and coverslip which form the floor and roof of the blood-chamber. It is now only necessary to clean away the clot. To do this the coverslip is removed while under the surface of the warm saline by passing beneath it the point of a knife or needle, and what remains of the clot and the plasticine is scraped away with a small knife. The slide should now be washed in the warm saline until all free red cells have been rinsed off. The slide may now be examined in saline under the warm stage or it may be kept for a time by means of a thin plasticine chamber constructed on a coverslip and filled with saline.

Æsculin Bile-salt Media for Water and Milk Analysis.*—F. C. Harrison and J. van der Leck recommend the use of æsculin in media especially when searching for *B. coli*. Æsculin is a glucoside and undergoes a hydrolytic fermentation when attacked by *B. coli* and other organisms. It splits into sugar and æsculetin, and the latter combines with the iron of the medium to form a dark-brown salt. The reaction

* Centralbl. Bakt., 2te Abt., xxii. (1909) pp. 547–52.

takes place only in sugar-free media. Colonies of *B. coli* are black and easily counted against a white background. Certain other organisms, notably *B. lactis aerogenes*, form black colonies, but are distinguishable from those of *B. coli* in being larger, moister, and more raised.

The method of making the media is given as follows: Weigh out 1–2 p.c. Witte's peptone; 0·5 p.c. sodium taurocholate; 0·1 p.c. æsculin; 0·05 p.c. iron citrate; 100 c.cm. tap-water. After steaming from fifteen to thirty minutes the medium is filtered and filled into test-tubes. For æsculin agar 1·5 p.c. agar is used, and after dissolving the agar in part of the water the remaining ingredients are added, brought to the boil and filtered, or else the medium is cooled by the addition of white of egg or albumen, again brought to the boil and then filtered and tubed. The tubes are afterwards sterilised in the usual way. In the broth the medium turns black. After inoculating tubes and slopes with the suspected fluid, the rest of the sample receives some 10 c.cm. of 4-times strength æsculin bile-salt broth and then all tubes, plates, bottles, etc., are incubated.

Modification of Kindborg's Acid-fuchsin Agar.*—Doepner appreciates Kindborg's acid-fuchsin agar for detecting *Bacillus typhosus* in stools and urine. To this medium, which is composed of agar stained red by means of 5 p.c. of saturated aqueous solution of acid-fuchsin, and also containing 5 p.c. lactose, the author advises the addition of malachite-green, thus combining the benefits of the two procedures.

Cultivation of Leishmania infantum, the parasite of Infantile Kala-azar.†—C. Nicolle shows that this disease occurs in Tunis, and describes the method he adopted for successfully cultivating this organism. Agar is macerated in cold water for 24 hours, the water being changed once. The amount of water absorbed is noted. The formula is as follows: agar 14 grm., common salt 6 grm., water 900 c.cm. This is distributed into test-tubes without neutralising or alkalinising, and then the tubes are sterilised in the autoclave. The tubes, the contents of which are liquefied at from 48°–52°, then receive one-third of their volume of rabbit's blood removed from the heart aseptically. The tubes are then sloped for 12 hours, and are afterwards incubated for 2 to 3 days at 37°. As the condensation water was small it was found advisable to add an equal volume of normal serum. The inoculations were made with a pipette or with a platinum loop. The foregoing method is a modification of that devised by Novy and McNeal.‡

Method of Detecting Indol.§—G. Morelli uses strips of blotting-paper soaked in a hot saturated solution of oxalic acid. When cold the strips are suspended in the culture tube, and if indol be formed they turn red.

New Method of Isolating Human Tubercle Bacilli.‖—F. W. Twort states that by means of a glucoside, ericolin, tubercle bacilli can be

* Centralbl. Bakt., 1te Abt. Orig., l. (1909) pp. 552–60.
† Ann. Inst. Pasteur, xxiii. (1909) pp. 361–401 (2 pls.).
‡ See this Journal, 1904, p. 116.
§ Centralbl. Bakt., 1te Abt. Orig., l. (1909) pp. 413–15.
‖ Proc. Roy. Soc., Series B, lxxxi. (1909) p. 248.

isolated quite easily from human sputum, though it be contaminated with other organisms. The glucoside is made up with distilled water to a 2 p.c. solution ; a lump of sputum is placed in a test-tube containing the ericolin and incubated at 38° C. for ¾ to 1 hr. Cultures are then made on Dorset's egg medium, and pure growths of tubercle bacilli will be obtained in 14 to 28 days. The tubes are sometimes contaminated with a few other organisms, chiefly streptococci and streptothrix, but they are so few that they do not interfere with the tubercle colonies, and subculturing is easy.

LENDVAI, J.—**Wie kann man die thermostaten mit alcohol einfach heizen.**
[Describes an apparatus for heating incubators, etc., by means of alcohol.]
Zeitschr. wiss. Mikrosk., xxv. (1909) pp. 303–6 (2 figs.).

(2) Preparing Objects.

Examining Euphausidæ.*— E. Taube filtered the catch through silk gauze, examined small portions under a simple Microscope, and picked up the objects with a pipette. If, however, the catch contained numerous eggs, as was the case in material obtained from Norway, there was no need to use a loup, and the filtered catch was at once fixed. The fixative chiefly used was Bouin's fluid (saturated aqueous picric acid 15, formol (40 p.c.) 5, acetic acid 1). After 3 to 5 hours the eggs were transferred to 70 p.c. alcohol, which was very frequently changed ; later on 96 p.c. alcohol was used. The stains mostly used were borax and picrocarmin. The preparations were examined in toto and in sections. To examine the eggs properly they must be rendered transparent by means of glycerin or of oil of cloves. The latter reagent, however, rendered the eggs too brittle, so was abandoned in favour of the former. In order to prevent shrinkage the transference from alcohol to glycerin must be extremely gradual, and at first the evaporation method must be adopted, the eggs being removed from 70 p.c. alcohol to a mixture of 2 parts 70 p.c. alcohol and 1 part glycerin. As the alcohol slowly evaporates the glycerin becomes more and more concentrated, and finally the eggs are quite clarified, and when in this condition give most excellent pictures of whole eggs and their contents. When examining eggs in sections greater difficulties are met with, chiefly those of orienting, but on reaching the gastrula stage the ordinary paraffin method gave fair results.

Studying the Relations between Acari and Cancer.†—A. Borrel fixes the pieces of skin removed during life from cases of suspected early cancer in the following solution : water 350, osmic acid 2, chromic acid 3, platinum chloride 2, glacial acetic acid 20.

Paraffin sections are made parallel to the surface of the skin and stained with magenta-red-picro-indigo-carmin, after the manner given in a previous memoir. Made in this way, about 200 serial sections from each tumour were examined, so that the appearances of the hairy system could be accurately studied at different and numerous levels. With a little practice the acari, when present, are easily recognised.

* Zeitschr. wiss. Zool., xcii. (1909) pp. 427–64 (2 pls.).
† Ann. Inst. Pasteur, xxiii. (1909) pp. 97–124 (4 pls. and 12 figs.).

Phosphomolybdic Acid as Fixative.*— B. Rawitz praises the virtues of phosphomolybdic acid for fixing tissues. Phosphomolybdic acid in solution (Kahlbaum) 40 c.cm., alcohol (93–95 p.c.) 50 c.cm., acetic acid 10 c.cm. The solution should be prepared fresh each time, though the alcoholic solution of the acid may be kept in stock and the acetic acid added just before use. The objects should be left in the fixative for 24 hours, and then transferred to up-graded alcohols from 70–100 p.c. Paraffin sections made in the usual way from the hardened material must be further treated for from 2 to 24 hours by immersing them in water to which an aliquot part (5 to 10 drops) of a 5 p.c. solution of calcium acetate has been added. They are then repeatedly washed in distilled water and afterwards stained.

Demonstrating the Organic Constituents of Enamel.†—L. Fleischmann imbeds small slices of enamel with the adjacent dentine in celloidin, and then, after the usual manipulation, decalcifies in 5 p.c. nitric acid. The slice is found to be decalcified when the celloidin becomes clear. It may afterwards be sectioned and stained in the usual way. Safranin is recommended.

Wash-bottle for Microscopical Purpose.‡—R. Krause has devised a bottle for washing microscopical preparations, the construction of which is intended to obviate the running dry or overflowing arising from variations in pressure of the water supply. As will be seen from the illustration (fig. 93), the inflow siphon has three elbows, the top of one being a little higher than the angle of the outflow siphon, the inside leg of which almost touches the bottom of the bottle, the interval being a mere capillary cleft.

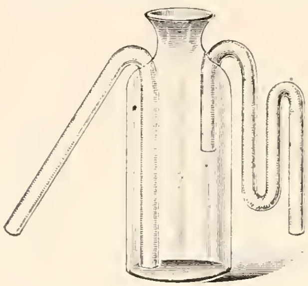

Fig. 93.

Demonstrating the Kinoplasmatic Connecting Threads between the Nucleus and the Chromatophores.§—B. Lidforss made thin handcut sections of the tissue and exposed them for from 5 to 15 seconds to the vapour of 2 p.c. osmic acid. The sections were then transferred to up-graded alcohols at intervals of about 2 to 5 minutes until absolute was reached; in this they were kept for 12 to 24 hours. When quite hard the sections were retransferred to water and afterwards stained. The stain mostly used was Zimmermann's fuchsin-iodin-green or fuchsin-methyl-green. Renault's hæmatoxylin-eosin occasionally gave good results.

* Zeitschr. wiss. Mikrosk., xxv. (1909) pp. 385–96 (1 pl.).
† Tom. cit., pp. 316–18.
‡ Zeitschr. wiss. Mikrosk., xxv. (1909) pp. 300–2 (1 fig.).
§ Acta Univ. Lundensis, iv. (1908) pp. 8–11 (4 pls.).

(3) Cutting, including Imbedding and Microtomes.

Leitz' Base Sledge Microtome.*— This instrument (figs. 94, 95) consists of a cast iron base provided with a horizontal slide bed, within which moves an accurately fitted heavy sledge which supports the object-carrier. The latter is raised by a micrometer mechanism which is mounted upon the sledge, but which is actuated independently of the motion of the sledge. The knife is supported by two pillars, which can, by means of T-bolts and variously placed slots, be clamped in any desired position, so that the knife may be fixed at right angles for paraffin cutting, or obliquely for celloidin cutting, with respect to the direction or motion of the sledge. When the object is exceptionally high the knife may be raised by placing below the knife-

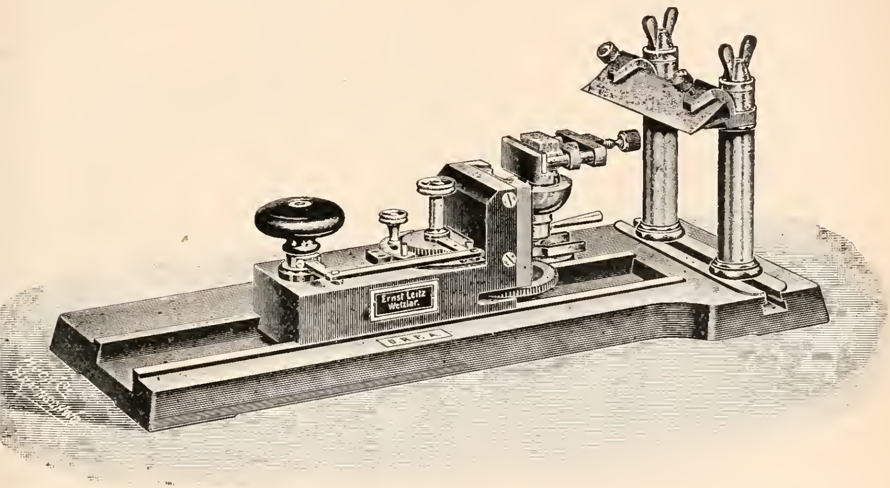

Fig. 94.

clamps the rings which are usually immediately below the wing nuts at the top of the pillars. The latter may, moreover, be placed as close together as the size of the object will admit, so that small preparations may be cut with a closely supported blade, and therefore under conditions of the greatest stability. Like the fixing of the knife, the bedding and movement of the object-holder insures the utmost degree of rigidity. The advantages resulting from this rigid arrangement for supporting the object are further enhanced by the addition of a new object clamp provided with a universal ball-and-socket joint. This clamp surpasses the usual form of cross-jointed clamps in that the preparation remains in all positions almost strictly at the centre of the clamping device. The micrometer movement is at the back of the sledge, and is operated by the rotation of a knob, which likewise serves to move the sledge to and fro. By suitably adjusting the

* E. Leitz' Special Catalogue, 1909, 4 pp. (2 figs.).

tappet a single rotation of the knob may be made to impart to the object an elevation varying from 0·001 to 0·020 mm. Thicker sections than these may be cut by turning the knob more than once. Any kind of knife may be used in conjunction with this microtome. Celloidin preparations are appropriately cut with a knife having a blade 24 cm. long and 33 mm. wide, and a back 13 mm. thick. The various parts of the microtome are either enamelled or nickel-plated.

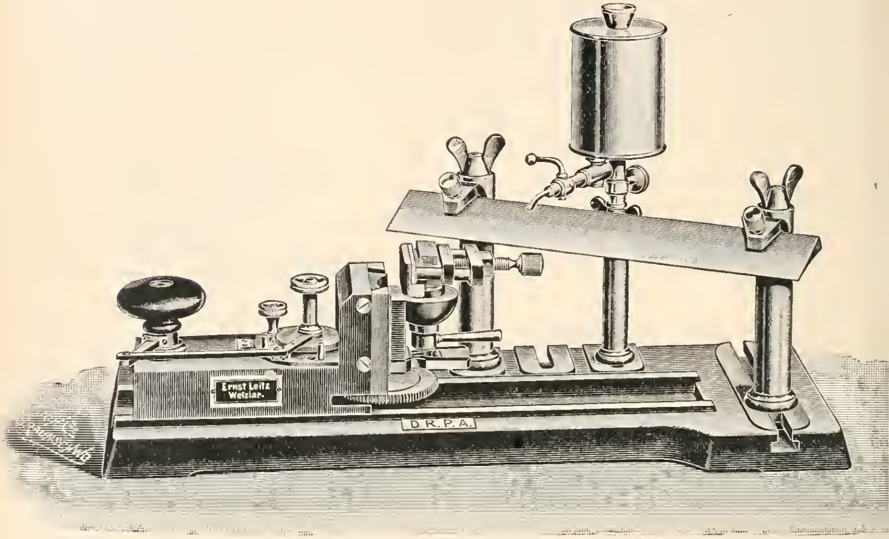

Fig. 95.

Rapid Examination of Tumours for Diagnostic Purposes.*—A. Leitch finds the following method gives very satisfactory results :— Thin slices of the doubtful tissue, about 1 mm. in thickness, are removed, and placed immediately in acetone and taken to the laboratory. The slices are transferred to hot water for a few seconds, dipped in gum solution, and placed on the stage of a freezing-microtome. The current of carbon dioxide is turned on, and the whole tissue is well frozen in less than one minute. The microtome used is a very handy little apparatus made by Leitz, the knife-carrier of which is sufficiently heavy to give a good momentum to the razor. The sections, as they fly off tangentially, are caught in a basin of water held by an assistant. They are floated on to a glass slide, the excess of water is dried off, and a drop of acetone solution of "krystallviolet" is placed on the section. This fixes it to the slide and stains it rapidly. The excess stain is removed with water and acetone, and the section is cleared with xylol, and is then in a condition to be examined under the Microscope. Good histological preparations can thus be obtained and may be kept permanently. Allowing 2 minutes for conveyance of the tissue from

* Brit. Med. Journ. (1909) i. pp. 1226–7.

the operating theatre to the laboratory, during which time the specimen lies in acetone, the author has found that on an average the whole time occupied, from the removal of the tissue till the diagnosis is given to the surgeon, is 7 minutes.

Combined Imbedding Method.*—Herzog Gandolfi hardens and dehydrates the object in upgraded alcohols, and then transfers to a mixture of equal parts of toluol and absolute alcohol for a day, and afterwards to a solution of celloidin in the foregoing fluids and having the consistence of cedar wood or olive oil. According to its nature the object requires from 3 to 7 days saturation. When sufficiently saturated the object is transferred to chloroform, in which are placed a few drops of ether and some bits of paraffin, and incubated at about 56° for some 15 minutes, and then transferred to pure paraffin for 30 minutes or so, after which it is imbedded and sectioned in the usual way.

HOYER, H.—**Eine neue Vorrichtung zu Injektionen.**
[An apparatus intended for injecting small animals.]
Zeitschr. wiss. Mikrosk., xxv. (1909) pp. 412–20 (3 figs.).

SSOBELEW, L. W.—**Zur Celloidintechnik.**
[Gives the author's precedure in minute detail for dealing with a celloidin section.] *Tom. cit.*, pp. 410–12.

(4) Staining and Injecting.

Differentiating Ergastoplasm and Mitochondria in the Human Submaxillary Gland.†—C. Regaud and J. Mawas find from their examinations that the mitochondria and ergastoplasm differ in shape, situation, and histochemical reactions. They deduce their conclusions from a comparative study of four kinds of preparation, viz.: (1) fixation with fluid containing 5 p.c. acetic acid; (2) fixation with formalin and chromic acid or a chromate. The tissues thus fixed were stained with (1) hæmalum and (2) iron-hæmatoxylin.

New Method for Staining Spirochæta pallida in Tissues.‡—J. Yamamoto has modified the original procedure in the following way. The tissue to be investigated may be preserved in various solutions, and is then cut into small pieces 10 mm. long and 5 mm. in thickness and breadth. These are washed free from the fixing medium by rinsing in water for 24 hours, and finally in distilled water for one hour. Each piece is then put into 10 c.cm. of a 5 p.c. solution of silver nitrate in brown-coloured bottles and kept at 37° C. for 48 hours. At the end of this time they are placed in a reducing solution containing 2 p.c. of pyrogallic acid and 1 p.c. of tannic acid in distilled water in similar brown bottles, in which they are kept for 24 hours at 37° C. It is, however, necessary to change this solution after the first half-hour, since it is rendered turbid by the reduction. After this the pieces of tissue are placed in water for an hour, and then washed in alcohol of increasing strength until decolorised; they are then imbedded in paraffin or celloidin, the latter giving better

* Zeitschr. wiss. Mikrosk., xxv. (1909) pp. 421–2.
† C.R. Soc. Biol. Paris, lxvi. (1909) pp. 461–3.
‡ Centralbl. allgem. Pathol. u. pathol. Anat., Feb. 29, 1909. See also Lancet, (1909) i. p. 933.

results. If it is desired to counterstain the tissues, the sections should be dipped in Löffler's methylen-blue solution for a second. The celloidin is removed in the usual way, and the specimen cleared by oil of origanum instead of by xylol, and then mounted in Canada balsam.

Staining Vegetable Phosphorus Compounds.*—C. Bongiovanni recommends the following methods for detecting organic phosphorus compounds in plant tissues, and has applied it to the seeds of *Ricinus communis*, wheat, and *Tropæolum majus*.

1. Sections of the seeds are warmed gently with dilute hydrochloric acid, washed several times with water, treated with 10 p.c. ferric chloride solution, again washed, immersed in 10 p.c. potassium thiocyanate, and, after further washing, examined under the Microscope, when the globoids are seen to be stained yellow.

2. The sections are immersed for about fifteen minutes in a saturated solution of molybdic acid in hydrochloric acid and then placed, without washing, in a 10 p.c. stannous chloride solution containing a few drops of 5 p.c. potassium or ammonium thiocyanate solution. In this way the cell-sap is coloured a faint yellow, and the globoids of the aleurone granules an intense reddish-violet, whilst the protoplasm either remains colourless or assumes a faint violet coloration.

Staining Fibrocartilage.†—B. Lunghetti obtains good contrast results by staining the sections for half-an-hour in the aqueous solution of tropæolin, and then after-washing in 0·2 p.c. methyl-violet for 1 to 5 minutes. After another wash the sections are immersed in 10 p.c. acetic acid for 5 minutes. Differentiation is obtained by means of alcohol. The basis is orange and the cells violet.

Another stain which gives good contrast by metachromatism is thionin, the hyalin substance being red-violet and the fibrous blue.

New Method of Staining Negri's Corpuscles.‡—F. Neri fixes smears with absolute alcohol and sections by Henke and Zellers' method. He then treats the preparations for 10 minutes in iodine-eosin, and after washing in distilled water, counterstains for 5 minutes with 1 per thousand aqueous methylen-blue. The preparations are then washed, dehydrated, and differentiated in 95 p.c. alcohol and mounted in balsam. The composition and preparation of the eosin-mordant are as follows: 0·1 grm. of iodin and 0·2 grm. potassium iodide are dissolved in a minimum quantity of distilled water, and then the mixture is made up to 50 c.cm. with distilled water. To this is added the eosin solution, made by dissolving 1 grm. of eosin in 50 c.cm. of distilled water. Negri's corpuscles assume a violet-red hue, and are therefore easily detected.

Silver-staining of Spirochæta pallida.§—J. Barannikoff fixed and hardened pieces of tissue, 1 c.cm. by 0·5 c.cm., in different fluids, e.g.

* Staz. Sperim. Agrar. Ital., xlii. (1909) pp. 116–20. See also Journ. Chem. Soc., xcv. and xcvi. (1909) p. 512.

† Zeitschr. wiss. Mikrosk., xxv. (1909) pp. 306–16 (1 pl.).

‡ Centralbl. Bakt., 1te Abt. Orig., l. (1909) pp. 409–12.

§ Tom. cit., pp. 263–7.

5–10 p.c. formalin, Zenker's, Kultschishky's, Schaudinn's. After treating the material when necessary with potassium iodide and hydric peroxide, the pieces were placed in upgraded alcohols and kept in 80 p.c. alcohol. Pieces of the hardened material not thicker than 2–5 mm. are placed in alcohols downgraded to 30 p.c., and then immersed in 1–1½ p.c. silver nitrate at 42° C. for 48 to 120 hours. On removal from the thermostat the pieces are washed for one hour in water, and then placed in 3–4 p.c. aqueous solution of pyrogallic acid at room temperature for 15 to 24 hours, or for a similar time in 10–7½ p.c. aqueous solution of "Agfa"-Rodinal. To the developer is added 3–4 p.c. formalin. On removal the pieces should be washed in running water for an hour, and then passed through upgraded alcohols to equal parts of alcohol and ether, and afterwards to pure sulphuric ether before imbedding in celloidin. The sections may be mounted at this stage in the usual way, or afterstained with hæmatoxylin-eosin, hæmatoxylin-fuchsin, methylen-blue and eosin, or the author's own stain for malaria parasites. All the foregoing procedures, from the moment when the pieces were placed in the brown-glass vessels filled with silver nitrate solution, were carried out in a dark room illuminated with ruby-red glass lamps.

Thionin and Picric Acid after Silver Impregnation of Spirochætes.*—J. Sabrazès and R. Dupérié have found that after staining sections of syphilitic organs by Levaditi's method it is advisable to counterstain with carbol-thionin and then treat with picric acid. The "thionine picriquée" method was devised by Sabrazès in 1897. By this combination the spirochætes are well shown against the yellow and green background of this preparation.

Vanadium-hæmatoxylin and Picro-Blue-black.†—M. Heidenhain recapitulates the formula of his vanadium-hæmatoxylin solution, and refers to his experience of this stain, which he has now used for over 15 years. To a freshly prepared 0·5 p.c. solution of hæmatoxylin is added half its volume of a 0·25 p.c. solution of ammonium vanadate. This should be kept in an hermetically sealed vessel and shaken daily until ripe (8 to 10 days). Connective-tissue, cartilage, etc., are blue, blood-corpuscles, nucleoli, and granules yellow, muscle yellowish brown, cell-plasma dark brown. For connective-tissue he finds the following useful: blue-black B, 1; picric acid, 400; methyl-alcohol, 80; water, 320. This solution may be used or diluted with an equal bulk of water. The stain should be used in conjunction with carmalum.

New Staining Methods.‡—B. Rawitz gives the following formulæ:

1. Nitro-hæmatein: Hæmatein 1 grm.; aluminium nitrate 10 grm.; distilled water 250 c.cm.; glycerin 250 c.cm. The aluminium nitrate is dissolved in the distilled water, the hæmatein is then added, and the mixture heated on a sand-bath to boiling. When cold the glycerin is added. The solution does not overstain.

* C.R. Soc. Biol. Paris, lxvi. (1909) pp. 690–1.
† Zeitschr. wiss. Mikrosk., xxv. (1909) pp. 401–10.
‡ Tom. cit., pp. 385–96 (1 pl.).

2. Nitro-cochineal: Cochineal 4 grm.; aluminium nitrate 4 grm.; distilled water 100 c.cm.; glycerin 100 c.cm. The powdered cochineal is added to the solution of aluminium nitrate, and the mixture is then heated on a sand-bath and allowed to boil for 5 minutes. When cold, the glycerin is added. The staining results are very permanent.

3. Cobalt-cochineal: Cochineal 4 grm.; cobalt-ammonium sulphate 4 grm.; distilled water 100 c.cm.; glycerin 100 c.cm. This solution is prepared on exactly similar lines to the foregoing. It keeps well.

4. Acid-alizarin blue B.B. Höchst: Acid-alizarin blue B.B. 1 grm.; aluminium-ammonium sulphate 10 grm.; distilled water 100 c.cm.; glycerin 100 c.cm. The pigment and the alum are dissolved in the water, and then heated on a sand-bath to boiling. The solution is allowed to cool slowly, and then the glycerin is added. It may be used after any fixative except Flemming. Sections are stained in the strong solution for $\frac{1}{2}$ to 2 minutes, and may then be mounted after washing in distilled water; but it is better to counterstain with picric-acid-fuchsin mixture.

5. Acid-alizarin green G Höchst: Acid-alizarin green G 1 grm.; aluminium-ammonium sulphate 10 grm.: distilled water 100 c.cm.; glycerin 100 c.cm. Prepared in similar way to foregoing. Sections are stained for $\frac{1}{2}$ to 2 minutes, washed in distilled water, and then counterstained with Van Gieson.

Permanence of Microscopic Preparations.*—M. Heidenhain states that sublimate-fixed objects which are treated with iodine do not keep well, but if de-iodised with sodium thiosulphate the iodine is completely removed. A 2·5 aqueous solution is diluted 10 times with water, and the yellow sections are completely bleached by its use in a few minutes. The author also alludes to the advisability of using neutral balsam, large cover-glasses, and as little balsam as possible.

(6) Miscellaneous.

Use of Atropin Sulphate for Anæsthetising Birds.†—R. Pearl and F. M. Surface find the following procedure most useful for anæsthetising birds for surgical operations. Immediately before beginning the administration of the anæsthetic (ether) a $\frac{1}{200}$-grain atropin sulphate tablet is dissolved in 1 c.cm. of warm normal saline solution, and is then injected subcutaneously into the axillary region. The anæsthetic is at once proceeded with and is administered from a mask, which permits the condition of the comb being seen during the operation. The bird is ready for operation in from 15–20 minutes after the anæsthetic has begun to be administered.

Detection of Spirochæta pallida.‡—A. C. Coles states that he has found the most certain and easiest method of detecting *Spirochæta pallida* is by the examination of cover-glass preparations made from the serum by means of dark-ground illumination. Examined by this

* Zeitschr. wiss. Mikrosk., xxv. (1909) pp. 397–400.
† Journ. Amer. Med. Assoc., lii. (1909) pp. 382–3.
‡ Brit. Med. Journ. (1909) i. pp. 1117–20.

method *S. pallida* appears as a shining silver-like thread with corkscrew turns lying in a black or blackish background. In order to obtain a satisfactory result it is necessary to make the films (wet or dry) from the serum only, or as little contaminated with red corpuscles as possible. Fixed films are best stained with Leishman's stain, which has less tendency to deposit than Giemsa's; but many anilin pigments made up with phenol answer very well. The serum may be stored up in sealed capillary tubes.

Detection of Seminal Stains on Clothing.*—Corin and Stokis have recently shown the affinity of spermatozoa for staining agents containing iodine such as Bengal rose and especially erythrosin. This last substance is a brown powder, forming in water a solution stable in the presence of ammonia. It is used in the strength of 1 in 200 in pure ammonia solution, in which form it keeps indefinitely. In examining a supposed seminal stain a single fibre of the fabric is removed with scissors, and immersed in the staining solution for 1 or 2 seconds. It is then transferred to a drop of distilled water on a slide which is placed on a dark background, and the fibre is thoroughly teased with needles. It may then be covered and examined with a low power, when the fibres of cloth being unstained it is easy to pick out masses of red points, which on higher magnification are seen to be the heads of the spermatozoa. The presence of the ammonia prevents the staining of the vegetable fibres while the spermatozoa are deeply stained, and their tails may be easily seen by using a small diaphragm. When the seminal stain has dried into the cloth the tails of the spermatozoa may be more difficult to demonstrate, but in this case a deeper coloration may be obtained by immersing the fragment of cloth before staining for a few minutes in Müller's fluid (bichromate of potash 1 part, sulphate of soda 2 parts, water 100 parts). This method is applicable to linen, cotton, silk and wool fabrics. The age of the stain seems of little consequence, spermatozoa being readily found in material 10 years old. The erythrosin solution stains most of the cellular structures of animal origin likely to be met with in suspected clothing such as pus, and epithelial cells, but while it shows these very clearly it does not detract from its value in the detection of spermatozoa, the appearance of which is characteristic.

REID, E. E.—**Electrically-controlled Gas-regulator.**
[Can be made quickly and easily out of materials at hand in the chemical laboratory, and is easily cleaned.]
American Chem. Journ., xli. (1909) pp. 148–52 (2 figs.).

* La Presse Médicale, Feb. 13, p. 120. See also Med. Record, 1909, p. 207.

Metallography, etc.

Application of the Microscope to the Study of Metals.*—Microscopic examination of metals is considered by W. Rosenhain as giving information upon (1) chemical constitution, the mode of combination of the elements present, and the relative arrangement of the constituents; (2) defects existing in the metal, and the causes of failure; (3) the intimate structure of the constituents and the behaviour of the crystals when the metal is strained. The author develops his theory of the structure of eutectics. The tin-lead eutectic appears to consist of spherulitic crystals of tin, between the dendritic arms of which the lead has been forced to solidify. The structure of all other eutectics examined is consistent with the view that the metal present in larger quantity forms a crystalline network, while the other metal solidifies in the interstices of this network. The forms assumed by laminated eutectics have a striking resemblance to the forms assumed under certain circumstances by thin films of liquids under the action of surface tension.

The author elsewhere † indicates the value of microscopic investigation of the causes of breakage of engineering materials. The first step should be the examination of the microstructure of the material close to the actual fracture, and also at some distance away from the fracture. The inclusion of microscopic examination in the regular tests carried out on engineering materials is advocated. The use of the Microscope to control the annealing of copper and its alloys is described.

Resistance of Metals to Impact.‡—T. E. Stanton and L. Bairstow have determined the relative resistance to shock of thirteen samples of wrought iron and steel of different carbon content. The methods of testing were—1. Bending-impact tests on notched specimens: (*a*) by one blow; (*b*) by repeated blows. 2. Impact tests by direct tension of plain specimens: (*a*) by one blow; (*b*) by repeated blows. Various static tests were made for comparison. The results obtained lead the authors to conclude that for the detection of two important faults in materials—brittleness and low elastic resistance—two distinct tests are necessary. The bending test on a notched bar seems to be the most searching; for the detection of brittleness the one-blow method should be used, while weakness in elastic resistance is revealed by the many-blow method. The development of slip lines in polished specimens submitted to alternate blows in tension and compression was found to be the same as under gradually applied alternating stress. Neumann lines were found in specimens broken by a very small number of blows.

F. W. Harbord § throws doubt on the value of impact testing because of the considerable variation between duplicate tests found in a comprehensive series of tests, which were carried out on various steels, to compare different methods of impact testing on notched bars.

* Journ. R. Soc. Arts, lvii. (1909) pp. 349–58 (6 figs.).
† Nature, lxxx. (1909) pp. 250–2 (2 figs.).
‡ Proc. Inst. Mech. Eng., 1908, pt. 4, pp. 889–919 (22 figs.).
§ Tom. cit., pp, 921–71 (12 figs.).

Ferromagnetism.*—P. Weiss discusses some of the consequences of Langevin's kinetic theory of ferromagnetism. He deduces from this theory that the magnetic investigation of an alloy resolves itself into the determination of the intensity of magnetisation at saturation, as a function of the temperature. The author's apparatus for this determination is described. The test-piece, in the form of an ellipsoid of revolution, is suspended obliquely between the poles of an electromagnet giving a field sufficiently powerful to magnetise the test-piece to saturation, and the moment of the couple acting on the test-piece is measured. For determinations at high temperatures the test-piece is suspended within a small electric-resistance tube furnace. It is suggested that α and β-iron are not two distinct phases, and that the thermal effects on heating and cooling coinciding with the change from α to β, or β to α, are caused by a change in specific heat.

Dimensional Changes produced in Iron and Steel Bars by Magnetism.†—W. J. Crawford found that the elongation of mild steel tensile test-pieces, maintained in a state of magnetic saturation throughout the test, was less than the elongation of similar test-pieces when unmagnetised. The amount of decrease of elongation caused by magnetism varied from 3 to 16 p.c.

Magnetic Alloys of Manganese.‡—F. Heusler and F. Richarz have continued their investigation of the magnetic properties of certain of the manganese-aluminium-copper alloys. Their explanation of the magnetic behaviour of these alloys is based on the independently established data (1) that copper and aluminium form a compound, $AlCu_3$; (2) that manganese and copper form a series of mixed crystals with a minimum in melting-point at a manganese-content of about 30 p.c.

Silicon-calcium Alloys.§—S. Tamaru has attempted the determination of the equilibrium diagram. Silicon and calcium are miscible in all proportions in the molten state. From about 35 p.c. to 100 p.c. silicon, practically pure silicon separates, which at 990° C. reacts with the 35 p.c. liquid to form the compound $CaSi_2$. No other compounds were found, but, owing to the great experimental difficulties encountered, their absence has not been definitely established.

Sulphur-arsenic System.‖—W. P. A. Jonker has investigated this system as an example of "heterogeneous equilibrium," since arsenic passes at atmospheric pressure directly from the solid to the gaseous phase. Both the melting-point and boiling-point curves were determined; the equilibrium diagram given accordingly includes the gaseous as well as the liquid and solid phases. As_2S_2 is partially dissociated in both liquid and gaseous states. As_2S_3 may be distilled without dissociation. No clear indication of the existence of As_2S_5 was obtained.

* Rev. de Métallurgie, vi. (1909) pp. 680–96 (7 figs.). (Paper presented to the International Congress of Applied Chemistry, London, 1909.)
† Nature, lxxx. (1909) p. 339.
‡ Zeitschr. Anorg. Chem., lxi. (1909) pp. 265–79 (3 figs.).
§ Op. cit., lxii. (1909) pp. 81–8 (1 fig.).
‖ Tom. cit., pp. 89–107 (4 figs.).

Nature of the Cast-irons.*—G. B. Upton adduces further evidence in support of his modification of the iron-carbon diagram.† The effects of silicon, phosphorus, sulphur, and manganese on total carbon and on graphite-content are analysed and expressed numerically. Grey cast iron has crystalline flake graphite mixed with a metallic matrix, which is a solution of silicon and carbon in γ-iron. White cast-iron is a super-saturated solution of carbon and silicon in γ-iron. Malleable cast iron has temper-graphite mechanically mixed with a metallic matrix, which is α-iron, ferrite, with more or less pearlite. None of the irons as cast are homogeneous from crystal to crystal.

Thermal Treatment.‡—L. Guillet indicates the importance of the time effect in the heat treatment of steel. The quenching temperature should exceed the highest critical point, but not by more than 50° C. A method of quenching frequently employed is to heat the steel considerably higher than this—say to 900°–950° C.—and allow it to cool to the upper critical point before quenching.

A. Portevin § discusses the heat treatment of alloys of copper. The properties of some of the copper-tin and the copper-aluminium alloys are modified by quenching. A correlation between the mechanical properties and the micro-structure of cold-worked brass annealed at various temperatures has been established.

Special Steels.‖—L. Guillet states that the alloy steels found to be industrially useful, are nearly all of the pearlitic class. The composition of several of these steels, and their mechanical properties after given treatments, are included.

Industrial Applications of Metallography.¶—L. Révillon signifies the directions in which metallography is usefully applied in the manufacture and employment of bronzes, brasses, and steels. Ferric chloride solution is a good etching reagent for bronzes and brasses.

Polishing Metals for Examination with the Microscope.**—A. Kingsbury recommends the use of paraffin-wax as a supporting substance for polishing powders. The polishing discs, grooved on the flat face, are warmed to about 100° C., laid flat, and the melted paraffin is poured on them to a depth of about ½ in., a removable ring or band retaining the melted wax. Hard foreign particles settle out before the wax sets. After the hardening of the wax, the discs are placed in the spindle of the polishing machine, and the face of the wax turned flat by a hand-tool. The author uses three grades of emery powder, which are mixed to a

* Journ. Phys. Chem. xiii. (1909) pp. 388–416 (10 figs.).

† See this Journal, 1909, p. 114.

‡ Rev. de Métallurgie, vi. (1909) pp. 807–9. (Paper presented to the International Congress of Applied Chemistry, London, 1909.)

§ Tom. cit., pp. 814–18. (Paper presented to the International Congress of Applied Chemistry, London, 1909.)

‖ Tom. cit., pp. 810–13. (Paper presented to the International Congress of Applied Chemistry, London, 1909.)

¶ Tom. cit., pp. 819–22. (Paper presented to the International Congress of Applied Chemistry, London, 1909.)

** Proc. Amer. Soc. Mech. Eng., xxxi. (1909) pp. 615–18.

paste with water and applied to the rotating wax discs with small brushes; rouge is used for finishing. A little water is required throughout the polishing process.

Polishing Machine for Metallographic Work.*—J. Aston describes a new machine of the vertical spindle type, with rotation of the polishing surface in a horizontal plane. The polishing discs are of sheet iron, held in position by a magnetic clutch, and can be replaced without stopping the machine. A number of V-shaped cuts are made near the circumference of the discs, and the points, bent down and sharpened, form fasteners on which the cloth or other covering material is hooked.

BROWN, W.—**Mechanical Stress and Magnetisation of Iron.**
Sci. Proc. Roy. Dublin Soc., xii. n.s. (1909) pp. 101–22, 175–89 (15 figs.).

DUMAS, A.—**Chaleur spécifique des substances ferromagnétiques, alliages de fer et de nickel.**
[Some theoretical considerations are discussed, and a detailed description of the method and apparatus used in the determination of the specific heat of high-nickel alloys at different temperatures is given.]
Arch. Sci. Phys. et Nat. (Bibliothèque Universelle) xxvii. (1909) pp. 352–82 (3 figs.).

ROSS, A. D., & R. C. GRAY—**Magnetic Properties of certain Copper-alloys.**
Proc. Roy. Soc. Edinburgh, xxix. (1909) pp. 274–86 (5 figs.).

GRAY, J. G., & H. HIGGINS—**Low-temperature Experiments in Magnetism.**
Tom. cit., pp. 287–94 (7 figs.).

SIEMENS, A.—**Tantalum, and its Industrial Applications.**
[Discourse delivered at the Royal Institution.]
Nature, lxxx. (1909) pp. 290–2.

ZOELLNER, A.—**Porzellan als Isolierungsmaterial vom physikalisch-chemischen Standpunkte.**
[The microstructure of some samples of porcelain is described.]
Electrotechn. Zeitschr., xxix. (1908) pp. 1257–8 (4 figs.).

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* Electrochem. and Metallurg. Ind., vii. (1909) pp. 15–16 (3 figs.).

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on the 16th of June, 1909, at 20 Hanover Square, W.
E. J. Spitta, Esq., M.R.C.S., etc., Vice-President,
in the Chair.

The Minutes of the Meeting of the 19th of May last were read and confirmed, and were signed by the Chairman.

The List of Donations to the Society, exclusive of exchanges and reprints received since the last Meeting, was read.

	From
Hans Hauswaldt, Interferenz-Erscheinungen an doppeltbrechenden Krystallplatten im Konvergenten polarisirten Licht. (4to, Magdeburg, Joh. Gottl. Hauswaldt, 1902)	*Madame Hauswaldt.*
Hans Hauswaldt, Interferenz-Erscheinungen im polarisirten Licht. Neue Folge. (4to, Magdeburg, Joh. Gottl. Hauswaldt)	*Ditto.*

The thanks of the Society were voted to Madame Hanswaldt for the two volumes presented.

Dr. Hebb said that since their last Meeting the Society had purchased a very interesting old Microscope by George Adams, which was in remarkably fine condition, almost as good as new. A description of the instrument written by Mr. F. A. Parsons, was read to the Meeting, and the Microscope itself was exhibited in the room.

The Chairman called the attention of the Meeting to an exhibition by Dr. J. A. Braxton Hicks, of a number of the better known Tropical Parasites which were the active causes of various diseases,—and asked Dr. Hicks to give some description of the examples shown.

Dr. Hicks said he had arranged these objects under 16 Microscopes on the table as follows :—

1. *Plasmodium malariæ*, showing "Daisy" forms or "rosette" stage of the Parasite of the Quartan Malaria just previous to the production of a rigor.

2. *Plasmodium vivax*, the Parasite of Benign Tertian Malaria, which had attained its full growth and was just ready to produce a rigor in the patient. (Showing "rosettes.")

3. This was a remarkable preparation (known as Sub-Tertian Malaria) showing the crescent form of Malignant Malaria and a double infection of Benign Tertian Malaria, obtained from the blood of the same patient.

4. *Amœba dysenteriæ*, the Parasite of Amœbic Dysentery.

5. The adult worm of *Bilharzia hæmatobia* (*Schistosomum hæmatobium*), showing the typical anterior and ventral suckers and the gynæcophoric canal.

6. The Ova of *Bilharzia hæmatobia* imbedded in the rectal mucosa.

7. *Filaria diurna* (*Microfilaria loa*) in the diurnal blood of a patient, the subject of Calabar swellings. Showing also the sheath and abrupt termination of the nuclear core.

8. *Filaria perstans*, showing the characteristic absence of sheath of this form of *Filaria*.

9. *Filaria medinensis*, Embryo from the uterus of the Guinea Worm. The adult female worm occupies the subcutaneous tissues of the leg, and having pierced the skin discharges the embryos when the leg comes in contact with cold water. These embryos then enter a *Cyclops* in which they undergo further development, and the water containing the *Cyclops* being drunk, infects the drinker.

10. *Filaria nocturna*, in a section of lung showing the embryos in the pulmonary vessels, where they remain during the day, coming out into the peripheral circulation only at night; the adult worm causes lymphatic obstruction and hence elephantiasis.

11. *Filaria nocturna* (*Microfilaria bancrofti*), in the nocturnal blood of a patient with hydrocele. Showing also the characteristic sheath and abrupt termination of the nuclear core.

12. *Trypanosoma gambiense*, from the blood of a rat inoculated with the blood of a case of sleeping sickness.

13. The Leishman-Donovan bodies found in the spleen and liver in cases of Kala-azar. Similar bodies are also found in the pus from Delhi boil, but any relationship between the two has yet to be proved.

14. *Spirochæte Obermeieri*, Spirillum of Relapsing Fever.

15. *Bacillus Lepræ* (Hensen's Bacillus), the Bacillus of Leprosy, taken from the nasal mucus of a case of Leprosy.

16. *Bacillus pestis*, section of lung from a case of Pneumonic Plague, showing the typical Bacillus in the tissues.

The Chairman was sure the Fellows present would give a very hearty vote of thanks to Dr. Hicks for this very interesting exhibit and for the explanatory remarks he had made with reference to the objects shown. Their thanks were also due to Messrs. Leitz and Mr. Ogilvy for the loan of the Microscopes under which the slides had been placed.

The votes of thanks were put to the meeting and unanimously carried.

Mr. J. W. Gordon said he had to report that the Society gave an exhibition of Metallurgical Microscopes at the Reception of the Members of the International Congress of Applied Chemistry, on June 1, at the Natural History Museum at South Kensington, on which occasion they were the only Society exhibiting. He had not received any formal acknowledgment from the reception committee, as they had not met since that date, but he had received a letter from the Secretary of the Congress saying that the Society's demonstration had been highly appreciated. He also wished to mention that at the next meeting of the "Brass and Glass" Section on Wednesday, June 23, there would be a demonstration of Petrological Microscopes.

Notice was given that the Rooms of the Society would be closed from August 13 to September 13.

The following Instruments, Objects, etc., were exhibited:—

The Society:—An Old Microscope by George Adams, presented to the Society by Members of the Council.

Dr. J. A. Braxton Hicks:—16 Slides of Tropical Parasites.

SPECIAL MEETING.

Pursuant to the notice given at the Meeting of May 19, 1909, the Meeting was then made "Special" for the purpose of receiving the Report of the Committee appointed on December 16, 1908, and of dealing with the proposal to amend the By-laws of the Society.

Mr. J. W. Gordon said it would be remembered that at the Special Meeting of the Society held on December 16 last, a resolution was passed in the following terms: "That in the opinion of this Meeting the time has now arrived when the question of the admission of women Fellows to the full privileges of the Society must be seriously considered, and that a Special Committee be appointed for the purpose of considering the proposals dealing with the subject, and of preparing a report thereon to be submitted to a further Special Meeting of the Society to be called for the purpose by the Council." This Committee had held seven sittings for the purpose of preparing their report, and with a view to ascertaining the feeling of the Fellows generally, they had sent out 284 circulars, to which 205 replies had been received. Of these 146 had expressed themselves in favour of a proposal to admit ladies to the Ordinary Meetings of the Society, whereas 42 were against it, and 17 signified that the writers were indifferent. With regard to the proposal to admit ladies to seats on the Council, 108 were in favour and 74 against it, whilst in reply to the request for the names of any ladies who would actually join the Society if the By-laws were altered, not a single name had been mentioned.

The Report of the Committee was then read by Mr. Gordon in the following terms:—

"At a Meeting of the R.M.S. held on December 16, 1908, a resolution appointing your Committee was passed in the following terms:—

"'That in the opinion of this Meeting the time has arrived when the question of the admission of women Fellows to the full privileges of the Society must be seriously considered, and that a Special Committee be appointed for the purpose of considering the proposal for dealing with this subject, and preparing a report thereon to be submitted to a further Special Meeting of the Society to be called for the purpose by the Council.'

"Your Committee proceeded forthwith to deal with the question referred to it, and has held seven sittings on the undermentioned dates for the purpose of preparing this report:—January 8; May 5, 13, 19, 26, 28; June 16, 1909.

"For the purpose of ascertaining the feeling of the Fellows of the Society upon the question proposed, your Committee drew up a circular and a reply post-card, of which 284 were issued to Fellows of the Society having postal addresses within the United Kingdom. Prints of the circular and of the post-card are appended to this report. To these circulars 205 replies were received—79 did not reply. The result of the replies actually received may be summarily stated as follows :—

"1. On the question of admitting lady Fellows to the Meetings of the Society, 205 replies were received. Of these replies 146 were in favour of admission, 42 were against admission, and 17 were to the effect that the writers were indifferent upon the subject.

"2. Respecting the question of the admission of lady Fellows to seats on the Council, about 108 of the answers received were in favour of the proposal, about 74 were against it, and about 23 were indifferent.

"3. With reference to the inquiry for the names of ladies who were desirous of joining the Society, the replies received yielded a negative result.

"4. In reference to the question of empowering the Council to issue invitations, it is difficult to state the result of the inquiry in a statistical form. In some cases it is clear that the writers have expressed themselves in favour of this proposal as being a second best, and in other cases have expressed themselves against it because it was only, in their opinion, a second best. It may, we think, be gathered as a whole result of the inquiry that upon this proposal four opinions are held: (1) a certain number of Fellows consider it the best proposal; (2) a very considerable proportion of Fellows consider it the second best proposal —some of these approve it as such; (3) others, thinking that it does not go far enough to be of substantial use to the Society, do not approve it; (4) a third section of the Fellows, more numerous probably than those who consider it the best proposal, but much less numerous than those who consider it the second best, are opposed to it as being an undesirable innovation.

"Your Committee has considered these expressions of opinion with great care, and has also considered the practical questions of convenience and inconvenience involved. Upon these more detailed matters, however, your Committee does not consider it necessary to present any report, forasmuch as the consideration of the larger questions involved leads, in the opinion of your Committee, to a definite result. Your Committee has therefore to report :—

"1. That your Committee has not been able to obtain any sufficient evidence of an existing desire on the part of ladies to share in the proceedings of the Society.

"2. That, having considered the probable effect of the proposed change upon the financial position of the Society, your Committee has not been able to discover any reasonably sure prospect of advantage to the Society in that way.

"3. That your Committee has received expressions of dissent from several Fellows of the Society such as to make it, in the opinion of the Committee, inexpedient to proceed further at the present time with the proposed alteration of the By-laws.

"4. That the attention of your Committee has been called to the provisions of the Charter and By-laws, which place the management of the Society's affairs in the hands of the Council, and apparently invest the Council with power, if it is thought expedient, to provide for the admission of ladies to Meetings of the Society."

Mr. Gordon also presented a Supplementary Report, signed by three members of the Committee, in the following terms:—

"We, the undersigned members of the Committee appointed to consider the question of the admission of women Fellows to fuller rights and privileges of the Royal Microscopical Society, beg to point out that in our opinion—

"1. The women Fellows of this Society, who have for so many years been called upon to pay the same entrance fee and annual subscription as men Fellows without enjoying the same rights and privileges, have a legitimate cause of complaint, which for the honour and in the best interests of the Society should be substantially removed.

"2. That the postal vote just taken shows that of the Fellows who took part in that vote a very large majority recognises the desirability of substantially meeting the demand for more equal privileges and rights for women Fellows.

"3. That it would be wise and expedient to meet the objections of many of the Fellows who, whilst in favour of admitting women Fellows to the Ordinary Meetings of the Society, view with some concern the possibility of their election to the Council and Committees of the Society.

"With these considerations in mind, they are of opinion that the By-laws should forthwith be amended in such a way as to to give women Fellows the right to attend the Ordinary Meetings of the Society.

John Hopkinson.
F. Cheshire.
Edwin J. Spitta."

Mr. Gordon also read to the Meeting the following letter from Mr. Scourfield:—

"Dear Mr. Gordon,—The notice of the Meeting of the Special Committee to-morrow evening only reached me yesterday. I am sorry to say I shall not be able to be present as I shall not be back in London until the end of the week; but my view about the Report remains as before. Without agreeing to the exact wording or even some of the paragraphs in the Draft Report as we last had it in Committee, I still think that in view of the possible secession of Fellows from the Society (which you have assured the Committee in most definite terms will take place if any alteration be made in the By-Laws at this time), it would be in the best interests of the Society for the Committee to advise that no change be made in the By-Laws at present. I firmly believe that that is also the view the majority of the Fellows in General Meeting would take if they had the same facts before them that the Committee has had. Of course, personally, I am very sorry that the opposition to any change in the By-Laws is so strong as to give rise to the probability of resignations, but as that probability exists, I feel bound to advise delay in carrying out what seems to me to be the wishes of the majority of the Society. Believe me, yours sincerely, D. J. SCOURFIELD."

Mr. Gordon then moved the following resolution: "That the Report of the Committee be adopted, and referred to the Council for consideration and the taking of such steps as may be in the best interests of the Society." He thought the question was one which it was very desirable that they should not decide upon off-hand. As stated in the report of the Committee, in reply to the inquiry for the names of ladies who would be prepared to join the Society if the by-laws were altered, no names had been submitted: so far as they knew, therefore, no ladies desired to join. It had, however, transpired that subsequently inquiries had been made by some of those gentlemen interested in promoting the proposal that had been made, one of whom made a communication in which he stated that he had ascertained that if the by-laws were altered there were half-a-dozen lady members of the Linnean Society who would be prepared to join this Society. This intimation was, however, made in a form very difficult to embody in the report. There was a possibility thus indicated that by passing the original resolution, they might secure an access of half-a-dozen ladies, but on the other hand they had received communications which showed that the passing of that resolution would lead to the immediate resignation of several Fellows, so that whilst it was not certain that they would be gainers financially, it was certain that they would thereafter miss from their Meetings some Fellows who were accustomed to take an active part in their proceedings. This was the reason for the remark in the report that there were considerations which made it very desirable that the matter should not be hurriedly decided; he thought it a fortunate circumstance that there was no urgency about the matter, as nobody was put to any actual inconvenience by the by-laws as they then stood. Still the proposal having received so much support, he thought it should not be altogether put aside but placed in a position in which it could be dealt with whenever it assumed a practical shape. It was manifestly a very difficult question, seeing that they had three reports before them, and he therefore suggested that it would be unwise to take any other course than that suggested by the Report of the Committee. It was not intended thereby to preclude discussion of the question, but it was intended to put it in a way of being disposed of easily, and without any unnecessary friction.

Mr. Conrad Beck seconded Mr. Gordon's resolution; there did not appear to be anything which could be considered urgent in the matter, as no ladies seemed to wish to attend the Meetings, and he thought the report of the Committee took a very fair view of it, and ought to be accepted.

Mr. Skinner asked how many ladies were at the present time Fellows of the Society.

Mr. Gordon said there were ten, of whom four were in America, three were in the provinces, and the rest within a hour or so of London.

Mr. Heron-Allen asked leave to move an amendment to the resolution moved by Mr. Gordon on behalf of the Special Committee. He had not been a member of the Special Committee, and could not know therefore what had caused them to come to the conclusions embodied in their report. The question appeared to him to be one of vital importance to the Society, and though he might say he was himself a militant "anti-suffragist," he entirely agreed with the minority report. Might he ask how many signatures were appended to the report they were asked to accept? This information was not available, but the Committee was composed of nine persons, of whom three had signed the minority report, and the originator of the movement was absent. It would therefore appear that the Committee was equally divided. He then proceeded to read quotations from what had been put before the Meeting of December 16 by Mr. Scourfield and Mr. Cheshire. He could not agree with Mr. Gordon that it was a matter to be decided by the Council, but thought it was rather one to be settled by the Fellows of the Society. On analysing the post-card ballot the result appeared to be that to 284 cards sent out 205 answers had been received, of which 146 assented to the proposal, so that even after eliminating those who had not replied, they still had a majority of the English resident Fellows in favour of admitting ladies, and he considered that to be a sufficient reason for carrying out the proposal. He should like to call attention to one or two observations in the report. It was stated that there was no desire on the part of any ladies to join the Society; but if that was so, how did it come about that the question had been brought forward? He thought that the mere fact of the question having been so strongly urged and supported showed that there existed a very strong desire upon the part of lady microscopists to be admitted to the Meetings of the Society. Then they were told that it would be detrimental to the Society financially, owing to the retirement of certain Fellows who objected to the presence of ladies at the Meetings, but he could not think there would be any considerable number of seceders, or that the seceders, if any, would not be more than balanced by the election of new lady Fellows. Mr. Gordon had also told them that they ought not to act in a hurry or upon insufficient consideration, but he observed that it was exactly six months since the question had been raised and the Special Committee appointed, and surely to deal with the matter now, and after a post-card ballot of the Fellows, could not be called being in a hurry. After dealing with some of the questions which had been raised, he then moved as an amendment that the report of the Committee be not received, but the minority report be adopted, and that the by-laws of the Society be altered accordingly.

Mr. Frederic J. Cheshire, in seconding the amendment proposed by Mr. Heron-Allen, said that he had very little to add to what he had already said on the subject at the December Meeting, and to that to which he had subscribed in the minority report just read. He would, however, point out that the acceptance of the proposal of the Committee to refer the further consideration of the question to the Council was, in effect, and in spite of the assurance of Mr. Gordon, a proposal to burke the question, since he (the speaker) was quite sure that they would get no more unanimity on the Council than there had been at the deliberations of the Committee whose report had just been read. The further suggestion that the Council should spoon-feed the women Fellows by inviting them from time to time to attend the Ordinary Meetings and hear certain selected papers read, he repudiated with scorn, as being an insult to the Fellows concerned.

Mr. Wesché said what they wanted to know was how many of the Fellows of the Society supported the proposal. They had ascertained this, and he thought they should act upon it—he was himself quite indifferent in the matter, but he thought the minority opposed to it based their opposition more or less on prejudice, and lacked reasonable arguments to support their contention.

Dr. Hebb, referring to the last speaker's remarks, said the opinion of such persons might be a little dogmatic and fanatical, but they had to deal with it notwithstanding. He had originally been in favour of the proposal, but in view of the information gained by the post-card ballot he felt that it might be prejudicial at the present time to adopt it.

Mr. J. H. Walters thought the Society had made a mistake in the past, the effect of which was shown by the report. In other Societies they had different grades of Membership, and if any alteration in the by-laws was to be made he would suggest the establishment of two grades—Associates as well as Fellows—the Associates having a different status from the Fellows, so that whilst they were admitted to the Meetings, they should not be eligible for election on the Council. If they admitted women as Fellows he did not see what was to prevent them getting on the Council. He preferred that the conduct of the business of the Society should remain, as at present, in the hands of business men. Science had no sex, and the Microscope was an instrument with which ladies could do excellent work, and it seemed to him that they would be doing themselves a wrong to exclude ladies. The object of a scientific society was to accumulate and classify knowledge, and if ladies could help to do this in any way, they ought to be welcome in numbers small or large.

Mr. Rousselet said he had seen Mr. Scourfield the previous day, and though he was the original mover in this matter, he was now, as a result of the deliberation of the Special Committee, in favour of Mr. Gordon's proposal.

The Chairman said that since the question was first raised, Dr. Hebb said that, personally, he had turned round in his opinion. He (the Chairman) had also turned round, but in the opposite direction, from being dead against the proposal to being in favour of it when he found that, whilst we took subscriptions from ladies we refused them the privileges. He considered further, that the whole circumstances had been changed by the result of the post-card ballot, which seemed to point in one direction, and one direction only. He thought, really, the opinion that any one individual held, must be made subservient to the opinion of the major number of the Fellows; this had been expressed in the most emphatic and unequivocal manner by the post-card return as already mentioned, and therefore it appeared to him, the present meeting could hardly go against such a determined expression "that ladies be admitted and with the full privileges of the male Fellows."

Mr. Gordon said it was very easy to exaggerate the value of the post-card ballot which had been taken from Fellows without any knowledge of the special circumstances which had to be taken into consideration. Thus it was probably assumed by most writers of the reply post-cards, that they were being asked to open the door for some more or fewer ladies who actually desired to attend the Meetings of the Society. Had that been the case, he should himself have taken a very different view from that which he actually entertained ; but so far as they knew, there was no lady who desired to take part in the work of the Society. The resolution embodied in the amendment had been put forward on entirely abstract grounds, and that to his mind was a fatal weakness. He repudiated the suggestion that the proposal of the Committee was intended to burke the question. They had no such desire—indeed, the Council could not even if it would burke the question, since a sufficient number of Fellows could at any time exercise their power of bringing it before a Special Meeting. He repeated that the resolution was framed without the least desire to prejudice the discussion of the question, but it was proposed by way of opening the door to an easy solution of the matter, and to avoid causing unnecessary irritation to those who were opposed to the proposal. Considering all that was involved, he did earnestly and seriously hope that the Meeting would pass the resolution he had moved. If, on the other hand, they wished to jettison Fellows whom they regarded as fanatical, the right way to do so was to pass the amendment.

Mr. Hopkinson said that as six lady Fellows of the Linnean Society had intimated their willingness to join the Society if they were granted full privileges of Fellowship, he thought it could scarcely be said that the Committee had no evidence of the desire of any ladies to take part in the Society's proceedings. The Committee had held seven meetings in the endeavour to agree upon a unanimous report, which was at last found to be impossible.

Mr. Walters inquired if, in the case of the amendment being lost, it would be in order to move another amendment on the lines he had suggested.

Mr. Orfeur thought it could not be moved as an amendment, but it might be put forward as a recommendation to the Council.

Mr. Gordon said that as a matter of fact they had not heard of any ladies who had definitely signified their intention to join the Society if the alteration in the by-laws now proposed by Mr. Heron-Allen was made.

Mr. Freshwater thought it was not a question of who they were going to bring in by the alteration, but whether the alteration was desirable. He thought it was likely they would gather many from outside if the alteration was made : it was a very important question, which should be voted upon and carried unanimously.

The amendment was then put to the Meeting by the Chairman, and declared by him to have been carried, 22 Fellows voting in its favour and 7 against.

On being put to the Meeting as a substantive resolution, 20 voted for it and 5 against, and it was then declared carried.

Mr. Walters moved that it be a recommendation to the Council that two grades of membership should be formed—Associates and Fellows.

Mr. Hopkinson said that the admission of Associates into the Society would involve the granting of a new Charter, the cost of which he thought would be prohibitive.

The Chairman said he regretfully ruled the proposal out of order, the Meeting being a special one called for a definite purpose.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

OCTOBER, 1909.

TRANSACTIONS OF THE SOCIETY.

XIV.—*On the Measurement of Very Minute Microscopical Objects.*

By Edward M. Nelson.

(*Read February* 17, 1909.)

It will be admitted that the methods of measurement of very minute microscopical objects, viz. those too small to span with the wires of a screw micrometer, are in a very chaotic state. Two methods appear to be in vogue: the first, is by making an accurate drawing by a camera and then by measuring the drawing; the second, is by making a photomicrograph and by measuring the image as before. In criticising these methods let the second case be taken first. The disadvantage of the photographic method is truly radical, for it is not always possible to photograph very minute microscopical objects. It is the blundering incompetent microscopist who discovers minute points by the photographic method; for there is not a single known microscopic object that has been discovered by photography, which cannot easily be seen visually through the Microscope in the ordinary way; but there are many objects that have been seen visually, which the most expert photomicrographers have been unable to image on the plate.

In my own experience only one object has been discovered photographically, but afterwards it was readily seen through the Microscope.

The disadvantage of the first method is, that the accuracy of the result depends entirely upon the skill of the delineator.

The new method, about to be described, though not free from objections, is probably better than either of the two plans just mentioned; for example, personal equation enters into the scheme;

this certainly is an objection, but hardly so serious as personal drawing.

Briefly then, the method is to bring the object just to the point of invisibility by reducing the W.A.* and then the correction for antipoint will be the measure of the object. Example: The flagellum of a certain micro-organism just disappears with a W.A. of 0·6, a screen being used; an inspection of the following antipoint correction table † shows that the correction for that W.A. is 0·00,000,618 inch, or 0·157 μ; this, therefore, must be the thickness of the flagellum.

W.A.	White Light. 45,300 ‡				Screen. 50,000 ‡			
	Inches.	Difference for ·01.	μ	Difference for ·01.	Inches.	Difference for ·01.	μ	Difference for ·01.
0·1	0·00004100	..	1·041	..	0·00003710	..	0·942	..
·2	2050	205	0·521	0·0520	1850	186	·470	0·0470
·3	1370	68	·348	·0170	1240	61	·315	·0160
·4	1030	34	·262	·0090	·00000928	31, 2	·236	·0080
·5	·00000820	21, 0	·208	·0050	742	18, 6	·188	·0050
·6	·00000683	13, 7	·173	·0030	·00000618	12, 4	·157	·0030
·7	586	9, 7	·149	·0020	530	8, 8	·135	·0020
·8	513	7, 3	·130	·0020	464	6, 6	·118	·0020
·9	456	5, 7	·116	·0010	412	5, 2	·105	·0010
1·0	410	4, 6	·104	·0010	371	4, 1	·0942	·0010
1·1	·00000373	3, 7	·0947	·0009	·00000337	3, 4	·0856	·0009
1·2	342	3, 1	·0868	·0008	309	2, 8	·0785	·0007
1·3	315	2, 7	·0800	·0007	285	2, 4	·0724	·0006
1·4	293	2, 2	·0744	·0006	265	2, 0	·0673	·0005
1·5	273	2, 0	·0693	·0005	247	1, 8	·0627	·0005

* See this Journal, 1901, p. 242. † Op. cit., 1904, p. 271.
‡ Number of waves in an inch.

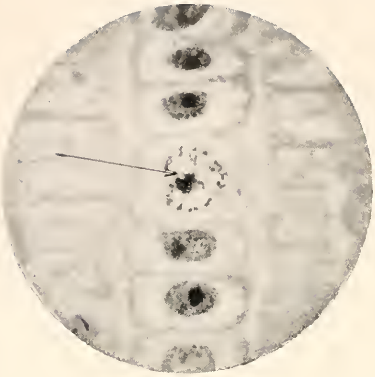
Fig. 1.

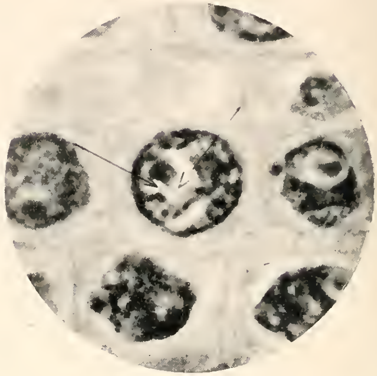
Fig. 2.

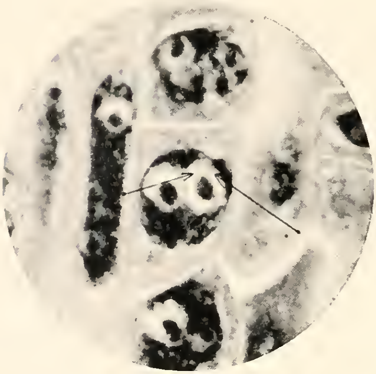
Fig. 3.

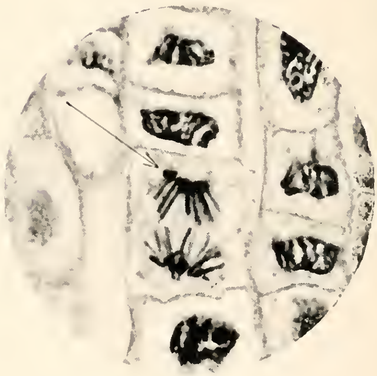
Fig. 4.

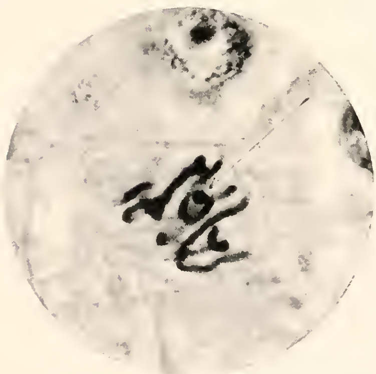
Fig. 5.

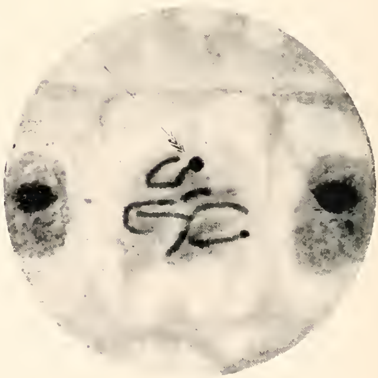
Fig. 6.

XV.—*The Disappearance of the Nucleolus in Mitosis.*

By E. J. Sheppard, F.R.M.S.

(*Read April* 21, 1909.)

Plate XIX.

Having made a great number of careful observations of fixed cells in the epidermis of tadpole, and comparing these with cells in growing root tips of *Hyacinthus*, the following remarks resultant from same may be of interest.

The fixing solutions used were as follows :—

1. Flemming's.
2. P. Bouin's picro-formol (slightly modified).
3. Lindsay Johnson's platinic mixture.

The formulæ, etc., for these solutions will be found in Bolles Lee's Vade Mecum, sixth edition, but the modification of Bouin's picro-formol used and made by me was the following :—

Saturated solution picric acid	150 c.cm.
Distilled water	150 ,,
Acetic acid	2 ,,
Formol	30 ,,

This formula I used more particularly for fixation of tadpole cells, but it is difficult to say whether better results were obtained thus than with the use of Flemming's or Lindsay Johnson's solution. I am inclined to give preference to either of the latter. The reason for reducing its strength was because I found that better differentiation or clearness was given than with the stronger formula.

The methods of staining adopted were Heidenhain's iron-

EXPLANATION OF PLATE XIX.

Fig. 1.—*Allium.* Peripheral contraction of nucleolus and association with chromosomes.
,, 2.—*Hyacinthus.* Fine processes extending from nucleolus to chromatin.
,, 3.—Ditto. Ditto.
,, 4.—Ditto. Late disappearance of nucleolus closely associated with chromosome.
,, 5.—Ditto. Ditto.
,, 6.—*Allium.* Late disappearance of nucleolus closely associated with chromosome.

hæmotoxylin, and thionin, particular attention being paid to the differentiation process.

One or two modifications were made regarding the strength of the hæmatoxylin solution, and length of time occupied in staining.

The use of thionin in my hands until late has, owing to its rather great tendency to fade, been somewhat disappointing. Although a very fine and powerful stain for this class of work, perhaps quite equal in its capacity to iron-hæmatoxylin for bringing out fine detail, the difficulty of maintaining the critical point of differentiation owing to fading has made me more than once think of giving up using it.

However, by continually trying different methods, I have found the following give the most satisfactory result, and up to the present hold the stain without any signs of depreciation.

The chief point to lay stress upon in the use of thionin as a stain, is to employ solutions after staining that are perfectly free, or as near free as possible, from acid reaction. Unfortunately, most of the essential oils used for clearing, are on the acid side, or very soon become so by keeping, and more often than not also, balsams are found in like condition and overlooked in this respect. I find cedar oil the most satisfactory to use and very nearly acid-free; but as the durability of thionin and the delicate staining with it is so easily affected by acid, it is as well to subject sections that have been stained by it to as short an immersion in cedar oil as possible, a time *just* sufficient to effect the proper clearing only, and mount direct in a perfectly neutral or natural balsam.

What I have been doing lately is to mount direct from absolute alcohol into natural or neutral balsam (Grübler), a process requiring much care. This latter although giving (as far as I am able to say) a permanent staining result, is not nearly so satisfactory regarding clearness of definition, which, however, for the examining of the finest details in connection with this subject of mitosis must be studied in preference to the former.

Coming to the other important part, the one of observation, of the mitotic figures; it will be easily observed upon examining the nuclei of many of the above-mentioned cells in their quiescent state, that the nucleoli stand out the most clearly and densely stained, next, the chromatin granules, least of all the linin network.

At a stage very soon after the first appearance of commencement of the spireme, the nucleoli take the stain less deeply in the central portion, the periphery remaining unchanged or very slightly affected.

As the development of the spireme proceeds, the staining power of the whole nucleolus diminishes to some extent, and signs of a granular appearance take place in the periphery, and a much more intimate association with the chromatin granules or thread is apparent, so much so that the nucleolus at this particular period presents a character similar to a capillary plexus (plate XIX. fig. 1). The staining, although much less pronounced, still remains more marked at the circumference.

It will be also noticed in the quiescent state that the majority of nucleoli are spherical; a few here and there may be observed in a more or less oval form, according perhaps as they may or may not be affected by the shape of the nuclei.

Again, at or nearing the completion of the spireme the nucleoli contract considerably, their outline becoming very irregular and much distorted, and in places having projecting processes not unlike small pseudopodia.

If very careful and critical observation under high power be conducted on cells in this particular phase, it will be observed in some that a very fine thread-like process, similar to that found connecting the several nuclei in the polymorphonuclear leucocytes in human blood, extends from the ends of these pseudopodia just mentioned, and is connected with the chromatin thread (plate XIX. figs. 2, 3). Much care is required in sighting these very fine structures, as their staining power not being very great they may be easily overlooked in consequence of the surrounding masses of other structure.

It may be not at all unlikely that by these processes just described the nucleoli are drawn into the nuclear thread, but the somewhat comparatively few cells to be found possessing these fine processes may leave a doubt in this direction.

However, the nucleoli appear at this time distinctly more granular in character, and so intimately associated with the nuclear thread, that finally its absolute disappearance takes place in such a manner that one is led to believe that it is taken up or entirely absorbed by the latter.

In the three figures (plate XIX. figs. 4, 5, 6), where a very late disappearance is exhibited, it will be observed that in fig. 4 the nucleolus is in contact with the crown, in fig. 5 near the end, and in fig. 6 absolutely at the end of a chromosome.

Much controversy and many theories have been advanced regarding the disappearance of the nucleolus in mitosis. Certainly it is a subject that requires a great amount of careful study, minute observations and investigations to be made before being in a position to come to any definite conclusion; but many of the preparations I have made, and the study of them from time to time, especially those of the epidermis of tadpole, and growing roots of *Hyacinthus*, have induced me to bring before your consideration this interesting subject.

In conclusion I should like to say that of all the methods, staining, and others tried by me, none have given such even results as the above. The observations, etc., mentioned are the outcome of a great amount of time having been spent upon the subject; also taken from exceedingly careful working, with sections cut, stained, and mounted, with a much higher sense of regard to the subject than the ordinary commercial slide.

In the case of tadpole I have done but very little sectionising; strips of the epidermis being used in almost all cases.

OBITUARY.

Henri van Heurck.

By J. B. De Toni, Hon.F.R.M.S.*

To the gaps already made in the ranks of the Honorary Fellows of the Society through the death of F. Castracane and J. Brun is now added another no less lamentable. Henri Ferdinand van Heurck, Professor of Botany and Director of the Botanic Garden at Antwerp, died in that city on March 13th, 1909.

H. van Heurck was born at Antwerp on August 28th, 1838. He began his scientific career by writing papers on floristic and medical subjects, but he soon became attracted to the study of Microscopy and especially Diatomology, soon taking rank among the most distinguished authors in these branches of science.

His handbook, Le Microscope, first published in Paris in 1865, has passed through subsequent editions, each an improvement upon its predecessor, in 1868, 1878, and 1891, in addition to the English translation published in London by Mr. Wynne E. Baxter, F.L.S.

H. van Heurck delighted to occupy himself with discussions relating to the optics of the Microscope, at one time studying the new combinations manufactured by E. Hartnack, Ross and Co., Powell and Lealand, Hasert, Reichert, and Zeiss; at another the camera lucida, the camera obscura, the illumination of objects under the Microscope; at another, again, the most appropriate liquids for the immersion and preservation of prepared objects. Of all these papers, suffice it to mention two—(1) his Étude des Objectifs Apochromatiques (1899), in which, after giving an historical and theoretical introduction, he summarises the chief forms of modern apochromatic objectives, and finally tabulates and compares the relative merits of the 3 mm. and 2 mm. apochromatics of the most modern types; (2) his Les Médiums à haute indice, in which he gives an excellent account of the resinous and chemical media employed for mounting diatoms—viz. Canada balsam, styrax, liquidambar, napthalin monobromide, methyl iodide, and Smith's arsenical medium (realgar dissolved in bromide of arsenic).

Henri van Heurck, having acquired a profound knowledge of the theory and practical use of the Microscope, dedicated himself almost exclusively to the study of the Diatomaceæ, discussing in his papers the structure of the valves, and above all the nature of

* Translated and edited by A. Gepp, M.A., F.L.S.

the striæ, making great use of photomicrography, which in Italy had already been employed by the Abbé Castracane as early as 1862. As an object for photomicrographic study, he made special use of *Amphipleura pellucida*, determining exactly the number of striæ, which differs very little from the number already determined by Castracane.

By the accumulation of observed facts, aided by the possession of a rich collection of slides, H. van Heurck arrived at a profound knowledge of the siliceous Algæ, with the aid of his illustrious friend Albert Grunow, who, in the words of van Heurck himself, "élucidant les cas difficiles, et, nous faisant part de dessins originaux si exact," facilitated, with Mr. Fr. Kitton, the editing of the well known Synopsis des Diatomées de Belgique, a work absolutely indispensable to botanists who would give themselves up to the study of the Diatomaceæ.*

But when the Synopsis became out of print, H. van Heurck conceived the idea of giving to science a work more accessible to the common run of diatomophils, containing descriptions and figures of all the species found in the North Sea and the countries surrounding it, that is to say, Great Britain, the extreme north of France, Belgium, Holland, Denmark, Norway. This idea took shape in The Treatise on the Diatomaceæ, first published (1896) in English under the editorship of W. E. Baxter, the skilled diatomist, who undertook not only the translation of the text but also all the cost of printing the English edition, of which he was to some extent the inspirer. In 1899 the same book was published in French (Traité des Diatomées) by van Heurck himself.†

The diatomologist finds in this important treatise valuable information on the morphology and biology of diatoms, on the mode of collecting, studying, and preparing the material, but particularly a section devoted to descriptive and systematic work, for which van Heurck has followed in his main plan the classification proposed by Hamilton L. Smith (1872) in the micrographic journal The Lens of Chicago.

The great Treatise, with 35 plates and numerous figures in the text, contains also some novelties, among which may be cited *Reicheltia*, a new genus allied to *Brebissonia* and *Berkeleya*; *Grunowiella*, a new genus created for *Sceptroneis gemmata* Grun. and *S. marina* (Greg.) Grun.; *Muelleriella*, a new genus of Melosireæ founded on *Pyxidicula limbata* Ehrb.; *Helminthopsis*, *Rutilariopsis*, and *Baxteria*, new genera belonging to the Biddulphiæ.

During the last few years van Heurck applied himself to the compilation of an algological florule of the Channel Islands (Prodrome de la Flore des Algues Marines des Iles Anglo-Normandes,

* Compare Delogne in Bull. Soc. Belg. Micr. xii. (1885–6) pp. 72–3.

† Compare the account given in Bull. Soc. Belg. Micr. xxv. (1898–9) pp. 25–6.

Jersey, 1908; xii. and 120 pp.), and also to the examination of the diatomiferous material collected by the 'Belgica' Expedition. We may hope that the fruits of the patient and conscientious toil of the learned micrographer may not be lost, and that some competent person will continue the work of our regretted colleague.

Henri van Heurck had numerous friends, and in the case of several of those friends who predeceased him he published affecting biographies extolling their merits; for instance, C. Janisch, E. Weissflog, J. Deby, C. Haughton Gill, E. Mauler, F. Kitton, J. J. Kinker. In this legion of experts van Heurck was second to none, whether in knowledge or in kindness. His survivors render a solemn tribute of respect to his memory.

A micrographer of great excellence, Henri van Heurck was honoured by Governments and by scientific societies. Among the latter the Royal Microscopical Society recognised his merits in 1883 by bestowing upon him the title of Honorary Fellow, thereby pronouncing him to be truly eminent in Microscopical Science.

The following is a list of the most important publications on Microscopy and Diatoms by the late H. van Heurck:—

Le Microscope, sa construction, son maniement et son application. Paris: Delahaye, 1865, 108 pp. Op. cit., 2nd ed., Anvers, 1868, 223 pp.; 3rd ed., Bruxelles, 1878, E. Ramlot, 346 pp., 12 pl. and 170 figs.; 4th ed., Anvers, 1891; English translation, London, 1893.

Synopsis des Diatomeés de Belgique, avec Atlas de 141 pls. Anvers, 1880–5.

Note sur les objectifs à immersion homogène. Formules de nouveaux liquides propres à cette immersion. Bull. Soc. Belg. Micr., viii. (1881-82) pp. xxii.–xxxi.

Types du Synopsis des Diatomées de Belgique. [Collection of 550 preparations of Diatoms, with Notes by A. Grunow, beginning from the year 1884 and continued in the following years.]

Le genre *Surirella* par M. Julien Deby, travail posthume traduit, mis en ordre et publié par le Dr. Henri van Heurck. Bull. Soc. Belge Micr., xxii. (1896) pp. 147–77.

Treatise on the Diatomaceæ. Translated by W. E. Baxter. London: Wesley, 1896.

Étude sur les objectifs apochromatiques. Ann. Soc. Belge Micr., xxiii. (1898) pp. 41–73 (1 pl.).

Les Médiums à haute indice. Ann. Soc. Belge Micr., xxviii. (1907) pp. 56–63.

Traité des Diatomées. Anvers: J. E. Buschmann, 1899. (8 pls.).

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Proportion of Sexes produced by Whites and Coloured People in Cuba.‡—Walter Heape notes that strong evidence has been brought to show that individual spermatozoa and ova have definite sexuality. It has been suggested that the sex of the offspring must be determined by either ovum or spermatozoon, not by both, and it has been claimed that a male ovum must be fertilised by a female spermatozoon, and, *vice versâ*, a female ovum by a male spermatozoon. So far as the evidence now goes, it would seem possible that in some animals the sex of the offspring is determined by the spermatozoon, and in other animals by the ovum. As regards Mammals, the evidence available is in favour of the view that the ovum determines the sex of the offspring.

A female Mammal produces only a limited number of her ovarian ova; others degenerate and are absorbed; there is a struggle for existence and a process of selection going on in the mammalian ovary. Just as female larvæ require more nourishment and more favourable conditions than do male larvæ, so the selection of male or female ovarian ova, for production, is liable to be influenced by the food supplied to the ovary by the mother, and therefore by the conditions of metabolic activity she experiences.

Variations in the proportions of the sexes may be referable to those extraneous forces which act as selective agents on the ovarian ova. In this connection Heape studied the proportion of the sexes produced by whites and coloured peoples in Cuba. The whites produce a larger proportion of males than the coloured people. In illegitimate births

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Proc. Roy. Soc., Series B, lxxxi. (1909) No. B 545, pp. 32–7.

there is a markedly increased proportion of females. There are two sharply-defined breeding seasons each year (in Cuba), and reference to records of temperature, barometric pressure, humidity, etc., shows that these bursts of reproductive activity always take place at times when there is a marked change of climate—the one in autumn, shortly after a sudden change from great heat to cooler weather; the other in the early months of the year, when the cool winter weather gives place to spring. The greatest excess of females is produced at times of greatest fertility, i.e., during the breeding season, when the metabolism of the mother is most active. The proportion of females born in towns is considerably higher than in country districts.

"While whites show a more marked sensibility to the influences which induce the production of females, coloured people are more affected by the forces which stimulate the production of males, and this condition is more marked among illegitimate than among legitimate birth records. This fact shows that the race which normally produces a considerable excess of males is most amenable to the forces which induce the ripening of female ova, while the race which produces the greatest proportion of females reacts more generously to the influences which favour the production of male ova. In other words, there is demonstrated the exercise of a force which limits the power to produce an excess of either sex, a force which makes for some point near equality of the sexes." This is the force of heredity.

"Extraneous forces undoubtedly exist which effect a variation in the sex ratio, but they are to some extent subordinate to laws of heredity; nevertheless, these former forces cannot be ignored: they are certain to interfere to some extent with the performance of the laws of heredity, and with all calculations regarding sex ratio which are based solely upon those laws."

To sum up the thesis:—"The variable metabolic activity of the mother, acting upon the ovary, induces a struggle for existence between the ovarian ova of different sexes, and affects the proportion of male and female ova which ripen, and which are produced for fertilisation."

"These same extraneous forces must affect the proportionate production of individuals possessing various kinds of different characters (quite other than sex) which are associated with metabolism, and, when better understood, may have valuable bearing on the means for selection of healthy ova and for preventing the maturation of ova bearing the active germs of disease."

Breeding Experiments with Rats.*—T. H. Morgan has bred the black rat (*Mus rattus*) and the roof rat or Alexandrian rat, which has the ticked or barred grey hair common to most wild rodents. It may be looked on as the original form from which the black rat has been derived. The hybrids were black. These inbred have, as yet, produced only one litter, four black and one grey. It seems that the two colours follow Mendel's law.

"If the black colour in the black rat is produced by the loss of the ticking factor, as Castle suggests for other black rodents, it is in-

* Amer. Nat., xliii. (1909) pp. 182–5.

explicable why the black should dominate when crossed with the ticked grey coat of the roof rat. If, on the other hand, the (black) rat has arisen by the black colour spreading over and obscuring the ticking beneath, then we could understand how it dominates in the first generation; also why the result is different from that when the black variety of the Norway rat (*Mus decumanus*) is crossed with a grey rat. It remains for further work to settle this point."

Function of Corpus luteum.*—P. Bouin and P. Ancel have experimented with rabbits, and have reached the following conclusions as to the influence of the corpus luteum on the uterus and the mammary gland. The corpus luteum determines the phenomena of hyperhæmia, hypertrophy, and structural transformation that are observed normally in the uterus during the first part of gestation. It also conditions the cellular multiplications which induce the development of the mammary gland during this period.

Regulation Phenomena.†—Al. Gurwitsch subjected to strong "centrifugal force" the eggs of *Strongylocentrotus lividus*, *Echinus microtuberculatus*, *Rana*, and *Triton*, and found that the plasmic structure was thereby dislocated. This is the first point of interest.

The nucleus remained unaffected, however, and the maltreated ova reconstituted their intricate plasmic structure and segmented. This is the second point of interest.

When frogs' eggs were subjected to the centrifugal machine, three zones appeared,—(1) at the "animal pole" a thin-walled vesicle; (2) a zone of plasma, free from yolk; (3) large yolk-masses at the "vegetative pole." Yet these ova developed into well-formed blastulæ. This illustrates what regulation means.

Strongly rotated eggs of the newt segmented before there was any restitution of the normal plasma-structure.

Ovary of Anthropoids.‡—H. Joseph has studied the ovary of an orang and of a gibbon. He discusses the morphological nature of the liquor folliculi, in which he finds definite cellular elements, and his conclusion is that the granulosa-cells give rise to both corpuscles and fluid.

He also discusses the zona pellucida which his researches refer to a follicular origin. The Call-Exner corpuscles, which seem to have an intercellular origin in the zona, are discussed at length. Like Regaud and Dubreuil, the author regards the granulosa cells as capable of producing (1) the zona and Call-Exner, (2) the liquor folliculi and (3) the intercellular substance.

Development of Tatusia.§—Miguel Fernandez has studied the development of the Edentate known as Mulita (*Tatusia hybrida* Desm.). He finds that there is an inversion of the germinal layers, as in *Mus* and *Cavia*, and that all the embryos of a birth (8–12) are developed

* C.R. Soc. Biol. Paris, lxvi. (1909) pp. 689–90.

† Trav. Soc. Imp. Nat. St. Pétersbourg, xxxvii. (1908) pp. 139–89 (9 figs.). See also Zool. Zentralbl., xvi (1909) p. 270.

‡ Arbeit. Zool. Inst. Univ. Wien, xviii. (1909) pp. 83–112 (1 pl. and 7 figs.).

§ Morphol. Jahrb., xxxix. (1909) pp. 302–33 (3 pls. and 3 figs.).

from one ovum. A separation into several embryos begins after the differentiation of the germinal layers.

Changes in Cicatricula of Unfertilised Egg of Fowl.*—A. Lécaillon points out that the cicatricula of unfertilised ova differs, even before the egg is laid, from that of fertilised eggs. It shows vacuoles in its peripheral region. These give rise to the "réseau de Prévost et Dumas," which occupies the periphery of the germinal disk.

Growth-period of Oocyte of the Fowl.†—Sonnenbrodt divides this into a period of development and a period of growth in the stricter sense. The former includes the time between the youngest stage of the nucleus and the resting stage. During this period the chromosomes are differentiated, they divide longitudinally, and a nucleolus arises. The growth-period includes a change in the nuclear sap, the breaking up of the nucleolus, the transformation of chromosomes into chromatin strands, the breaking up of the strands into very fine granules, the migration of the nucleus to the surface of the egg, the formation of chromatic nucleoli, and the new formation of chromosomes.

Development of Cornea in the Chick.‡—Ernst v. Knape finds that the development of the cornea in the chick is determined by three factors—the ectoderm, the anterior vitreous body, and the mesoderm cells. The ectoderm over the primordium of the eye is turned into the corneal epithelium. In the anterior vitreous body a thickening arises—the directive membrane of the cornea—which determines the direction and limits of the immigration of mesoderm-cells that form the endothelium. This directive membrane becomes the *membrana Descemetii*. The part of the anterior vitreous body lying between the directive membrane and the ectoderm forms in part the framework for the immigrant mesoderm cells, from which the substantia propria arises, and persists in part as Bowman's membrane.

Influence of Size of Egg and Temperature on Growth of Frog.§—Robert Chambers experimented with eggs of *Rana temporaria* and *R. esculenta*, seeking to determine how the initial size of the eggs and the temperature affect the size of the developing embryos. He found that small eggs have a tendency to develop rather faster, that large eggs are more efficient in withstanding extremes of temperature, that large tadpoles develop always from large eggs, that the size of the cells of a tadpole or young frog is in direct relation to the size of the examined individual, that therefore the size of the cells of an animal is determined by the initial size of the egg from which it has developed.

Three-year-old Tadpoles.‖—W. Ahrend describes tadpoles of *Pelobates fuscus* which have remained as tadpoles for three years. The cause was mainly lack of sufficient food. While caudal fin and branchial respiration persisted, the spirally coiled gut was replaced by a short gut like the adult type.

* C.R. Soc. Biol. Paris, lxiv. (1908) pp. 1035–6.
† Archiv Mikr. Anat., lxxii. (1908) pp. 415–80 (4 pls.).
‡ Anat. Anzeig., xxxiv. (1909) pp. 417–24 (4 figs.).
§ Archiv Mikr. Anat., lxxii. (1908) pp. 607–661 (9 figs.).
‖ SB. Nat. Ver. Preuss. Rheinland, 1909, pp. 43–4.

Embryo of Chlamydoselachus anguineus.*—H. E. Ziegler describes three embryos of this interesting Japanese Selachian, which measured 25 and 75 mm. He discusses "Seesel's pouch" and "Ratke's pouch," the pre-mandibular and mandibular cavities in the head, and the cranial nerves.

Study of Heredity.†—M. Nussbaum gives a sketch of the great steps of cytological inquiry in regard to heredity, from his own statement in 1879 of the general idea of germinal continuity to the recent work of Wilson and others.

b. Histology.

Bipolarity of Cell-division.‡—Angel Gallardo re-states his dynamical interpretation of cell-division. Typical division depends on the intense positive polarisation of the centrosomes, followed by the intense negative polarisation of the chromatin. The gametes are unipolar; their union restores the bipolarity which is an essential condition of cell-division.

Mitochondria of Seminal Epithelium of Rat.§—Cl. Regaud finds that mitochondria are not fixed parts of the cytoplasm. They change with the functioning of the cell. They are not permanent elements of the nutritive syncytium, and are evidently connected in some way with the development of the spermatozoa in the seminal epithelium.

Intestinal Musculature in Tench.‖—E. Retterer and A. Lelièvre describe in detail the smooth muscle of the muscularis mucosæ and the striped muscle of the muscular tunic. In both cases the muscular elements show a reticulum (strongly stainable with hæmatoxylin), and a hyaloplasm (selecting alum-carmin). There is a fundamental resemblance between the two types of muscular element, but a difference of arrangement.

Thyroid and Parathyroid.¶—J. Halpenny and F. D. Thompson have published four sections which go to show the intimate morphological relationship between thyroids and parathyroids. After removal of the thyroid from a dog, the external parathyroids were to all intents and purposes converted into thyroid. The most noticeable feature about the thyroid tissue which has developed from parathyroid is the irregular shape of the vesicles, but the appearance thus presented is strikingly similar to that which is found in the thyroid gland after parathyroidectomy.

Structure of Afferent and Efferent Arteries of the Renal Glomerulus in Mammals.**—G. Vastarini Cresi finds that the afferent and efferent artery of the renal glomerulus differ in structure. The walls of

* Anat. Anzeig., xxxiii. (1908) pp. 561–74 (7 figs.).
† SB. Nat. Ver. Preuss Rheinland, 1909, pp. 13–25.
‡ Revista Mus. La Plata, xvi. (1909) pp. 7–31.
§ C.R. Soc. Biol. Paris, lxv. (1908) pp. 566–8.
‖ Op. cit., lxvi. (1909) p. 571–4.
¶ Anat. Anzeig., xxxiv. (1909) pp. 376–9 (4 figs.).
** Tom. cit., pp. 94–105 (1 fig.).

the afferent artery consist of :—(1) the endothelium, (2) the elastica of the intima, and (3) the muscular envelope. The walls of the efferent artery consist of :—(1) the endothelium, and (2) the muscular envelope. This difference was seen in ten different Mammals, and is related to a functional difference.

Structure of Myocardium.*—E. Retterer and A. Lelièvre has studied this in tench, frog, and tortoise. The cells of the myocardium have, besides the nucleus, a chromophilous and elastic framework. In the interval between two cells the elastic framework is most developed, and it gives off lateral " ramusculi " which penetrate into the fibre-cells, becoming continuous with their chromophilous and elastic reticulum. The intertrabecular " bandelettes " of the fibre are partitioned by the lateral ramusculi or striæ of Amici.

c. General.

Experimental Biology.†—Hans Przibram has discussed in a lecture the application of experimental methods in relation to the fundamental questions of biology. He refers to such instances as artificial parthenogenesis ; to Weindl's chemical proof of the presence of the antecedents of future pigment in the transparent eggs of the squid ; to Hadzi's observation on *Hydra viridis* that eggs laid in the dark developed into white polyps, since the symbiotic Algæ, which usually migrate from mother to germ, do not migrate when there is no light stimulus ; to the evidence of regenerative capacity in unexpected situations – in *Ophryotrocha*, in the leech, in fresh-water snails, in *Amphioxus*, in the limbs of the fresh-water spider and the praying mantis, in the lungs of the salamander, in the jaw of lizards ; to Kammerer's argument that artificially induced changes in the mode of reproduction may be transmitted ; to the change in a hermit crab's abdomen when it is allowed no shell to hide in ; and to many other interesting cases.

Chemical Nature of Albinism.‡—G. P. Mudge has followed up Cuénot's suggestion that albinos are colourless, because their skins lack one of two factors, a chromogen or a ferment. Durham's results indicate that the hair or skin of pigmented animals contains a ferment (tyrosinase ?) which, acting on tyrosin, produces a pigment. The skin of albinos, on the other hand, gives negative results. We may therefore tentatively infer that the albino lacks the ferment and carries the chromogen. Mudge treated albino rats by immersion in a solution of 10 p.c. formalin and 70 p.c. spirit. In a short time the hairs became vivid yellow. That this coloration is due to the presence of a specific body, diffused through the keratin, and not to mere reaction between the keratin and the formalin, is suggested by various observations.

Races of Indian Rats.§—R. E. Lloyd has made a careful study of the races of Indian rats. He discusses the numerous single sports, the

* C.R. Soc. Biol. Paris, lxvi. (1909) pp. 747–9.
† Verh Zool. Bot. Ges. Wien, lviii. (1908) pp. 170–80.
‡ Proc. Physiol. Soc. Journ. Physiol., xxxviii. (March 27, 1909) pp. 1–2.
§ Records Indian Museum, iii. (1909) pp. 1–100 (7 pls.).

small family groups of such sports, the larger groups, and the four established races (of the *Mus rattus* type)—*M. vicerex* (?), *M. nitidus* (?), *M. blanfordi*, and *M. jerdoni*. The result of his inquiry is to leave him with the conviction that races may arise from sports.

Hairs on Mole's Hand.*—Julius Kazzander points out that the hairs on the forearm of the mole are separated by a broad bare band from a regular semicircle of hairs on the proximal margin of the palm. These hairs are bent in a concave curve with their free ends towards the palmar surface. Many of them are sinus hairs, as Merkel noted in 1880, and have doubtless significance as tactile structures.

Notes on Ungulates.†—F. E. Beddard contributes a number of notes on anatomical peculiarities of various Ungulata. The Himalayan tapir (*Tapirus indicus* or *malayanus*), like the two species of elephant, has a pleural cavity which is mainly obliterated by the formation of a dense network of strands of connective-tissue uniting the two layers of the pleura. In *Hyrax dorsalis* (as in *H. syriaca*, described by Lonsky) there is a third cæcum about an inch long lying between the unpaired cæcum and the paired cæca. The orifice of the ileum into the unpaired cæcum has a circular valve. The azygos vein in *Hyrax capensis* is, as a rule, confined to the right side of the body. An additional vein on the left side is rare. The sulci of the brain of *Hyrax capensis* show considerable variation. In *Hyrax*, as in *Elephas*, there is a free fold of peritoneum of considerable dimensions attached to each testis and floating in the abdominal cavity, the homology of which is doubtful. Many other notes deal with points in the structure of *Antilocapra*, Musk-ox, *Babirussa*, etc.

Asiatic Horns and Antlers.‡—T. Bentham has made a useful catalogue of the horns and antlers in the Indian Museum, Calcutta. Good illustrations and careful measurements are given.

Abnormal Incisors of Woodchuck.§—Charles A. Shull describes a case where the upper incisors of *Marmota monax* were extremely long and curved, so as to form with the parts imbedded in the premaxilla more than a complete circle. The abnormal growth depended primarily upon a congenital abnormality in the position and direction of the socket of the left incisor.

Respiration in Tortoise.||—Ch. A. François-Franck has made an intimate study of the physiology of respiration in the Greek tortoise. He describes the respiratory movements and analyses their effects. A full account is given of the lung, its contractility and innervation.

Synopsis of Chelonia.¶—F. Siebenrock supplies a useful synopsis with diagnosis of extant Chelonia and recently exterminated forms. He deals with 232 species in 57 genera.

* Anat. Anzeig., xxxiv. (1909) pp. 394–9 (2 figs.).
† Proc. Zool. Soc., 1909, pp. 160–97 (10 figs.).
‡ Published by order of the Trustees Indian Museum, 1908, 97 pp. (numerous pls.).
§ Amer. Nat., xlii. (1908) pp. 457–9 (2 figs.).
|| Arch. Zool. Expér., ix. (1908) pp. 31–187 (1 pl. and 126 figs.).
¶ Zool. Jahrb., supplement, x. heft 3 (1909) pp. 427–618.

Survival after Injury in Toads.*—W. E. Kellicott examined a natural group of *Bufo lentiginosus americanus* Le C. consisting of 434, and found that 22, or 5·07 p.c., showed injuries, such as crushed feet, broken shank, broken shoulder-girdle. That injuries such as these are not very considerable factors in non-survival is indicated by the fact that the average weight of the 22 injured specimens was 38·5 gr., as compared with 44·8 gr. for the entire colony. In addition to the 5 p.c. injured, 16 individuals, or 3·68 p.c., showed abnormalites, some of which were serious handicaps. It should be added, however, that, on the whole, the conditions of life were not rigorous for this group of toads. Food was more than abundant, means of protection and concealment were ready, and natural enemies did not seem to be numerous.

Mackerel and Sunshine.†—E. J. Allen discusses the factors affecting the abundance of mackerel. G. E. Bullen has shown that there seems to be for 1903–7 a correlation between the number of mackerel taken and the amount of Copepod plankton. The food of Copepods seems to be large diatoms and Peridinidæ. The vegetable plankton is affected mainly by the composition of the sea-water, the temperature, and the amount of light available. No simple relation has been shown between salinity and plankton-production, and the curves showing the temperature of the surface-water during the fishing months in the different years do not suggest any close connection with mackerel catches. But there seems to be a definite connection between the abundance of mackerel and the amount of bright sunshine.

Ear of Flying Fish.‡—N. D. Tschernoff has studied the ears of *Exocœtus volitans* and *E. rondeletii*, and has found some errors in the acconnt given by Retzius. In all its parts the ear of the adult is well-developed and in proportion. The following are characteristic features: the long and narrow semicircular canals; a moderately marked apex; a small ductus endolymphaticus; a large sacculus, to which the faintly limited lagena is annexed; the presence of the macula acustica neglecta, and the absence of a canalis reuniens.

Abnormal Brill.§—Jas. Johnstone describes a brill (*Rhombus lævis*) with a partially arrested metamorphosis, manifested in the incomplete translation of the right eye. The fish is coloured on both sides, but on the blind side part of the head is quite unpigmented.

Inferior Lobes of Torpedo Brain.‖—L. Gentes notes that the inferior lobes are direct lateral expansions of the *saccus infundibuli*, and that their cavity, which persists throughout life, is a diverticulum of that of the third ventricle. They form a sort of transition between the thick wall of the brain and the infundibular gland.

* Science, xxvii. (1908) pp. 855–7.

† Journ. Mar. Biol. Assoc., viii. (1909) pp. 394–406 (5 figs. and 7 tables).

‡ Anat. Anzeig., xxxiv. (1909) pp. 91–4 (3 figs.).

§ Report Lancashire Sea-fisheries Laboratory, xvii. (1909) pp. 98–100 (2 pls. and 1 fig.).

‖ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 836–8.

Hereditary Immunity to Rabies.*—P. Remlinger finds that in the rabbit the role of the male parent in transmitting anti-rabic immunity is nil. The role of the mother, however, is real, especially when the immunisation is effected during gestation and in an intensive manner. Even then the influence is very variable. We do not know why the author calls it hereditary.

Immunity of Snakes to Amphibian Poison.†—M. Phisalix has shown experimentally that some snakes show a marked relative immunity to salamandrine, which holds good however the poison is introduced.

Tunicata.

Pelagic Tunicates of Gulf Stream.‡—The late W. K. Brooks described the rare *Salpa floridana* (Apstein), and defined the subgenus *Cyclosalpa*, including *S. pinnata*, *S. affinis*, *S. virgula*, and *S. floridana*. Along with C. Kellner he described *Oikopleura tortugensis* sp. n. from the Tortugas.

INVERTEBRATA.

Mollusca.

Molluscs from Bay of Biscay.§—A. Reynell reports on 75 species collected by the 'Huxley'—Amphineura (1), Pelecypoda (34), Scaphopods (2), Gastropods (37), Nudibranchs (1). Of the 75 species, 62 have been recorded from the British area. The remaining 13 are: *Pecten bruéi*, *Lima marioni*, *L. excavata*, *Emarginula multistriata*, *Calliostoma obesulum*, *Natica operculata*, *Ranella gigantea*, *Scala richardi*, *Pseudomurex richardi*, and *Cavolinia trispinosa*.

α. Cephalopoda.

Olfactory and Tactile Sensitiveness of Octopus.‖—S. Baglioni blinded some cuttlefishes and fishes with a glowing glass rod, and made some striking experiments after the creatures were quite healed and showed spontaneous desire for food. (1) As to the sense of smell, an octopus detected a dead *Trachurus* (without head or viscera) at a distance of 1·5 m., and found it in 5 minutes 5 seconds. The seconds show the precision of the experiments. The fish *Balistes* did the same sort of thing. (2) As to the sense of touch, the octopus reacted by colour-change and contraction to the slightest sudden vibrations in the water, whether that was in motion or not before the stimulus. Very loud noises had no effect.

γ. Gastropoda.

Revision of Chitons.¶—J. Thiele describes a number of new species of *Lepidopleurus*, *Trachydermon*, *Tonicella*, *Plaxiphora*, *Craspedochiton*, *Aristochiton* g. n., *Loboplax*, and *Notoplax*, and corrects a number of mistakes that have been made in previous naming.

* Ann. Inst. Pasteur, xxiii. (1909) pp. 430–40.
† Comptes Rendus., cxlviii. (1909) pp. 857–60.
‡ Carnegie Institution, Washington, Publication 102 (1908) pp. 73–94 (8 pls. and 3 figs.).
§ Journ. Mar. Biol. Assoc., viii. (1909) pp. 359–91.
‖ Zentralbl. Physiol., xxii. (1909) 5 pp. See also Zool. Zentralbl., xvi. (1909) pp. 270–1.
¶ Zoologica, xxii. (1909) heft 56, pp. 1–70 (6 pls. and 5 figs.).

Homing of Limpets.*—G. Bohn discusses the so-called local memory of *Patella*, and gives the results of a large number of experiments. He finds that the homing is not always certain. Gravity seems to influence the movements. There are lines of least resistance on the rocks which are followed, as one might follow them in a forest. But it is not necessary to invoke a muscular or visual memory.

Pallial Cæcum in Bulloidea.†—Rémy Perrier and Henri Fischer have investigated the diverticulum of the pallial cavity in *Actæon* and *Scaphander*, which forms a long tube ending in a cul-de-sac, and coiling within the shell, parallel to the visceral mass, yet without fusing with it. This pallial cæcum is found in all the Bulloidea. It contains two ciliated bands. It may be free, e.g. in *Aphistrum*, or adherent, e.g. in *Acera*, or in a devious spiral of its own, e.g. in *Bulla*.

Pteropods and Heteropods of Coasts of Ireland.‡—Anne L. Massy reports on a collection of seventeen species, seven of which have not hitherto been recorded from the British Islands. The collection includes *Clione gracilis* sp. n., distinguishable from *C. limacina* Phipps by the large head, narrow body, absence of coloration, and differences in the spines of the hook-sac and teeth of the radula. The Heteropoda are only represented by a few records of *Carinaria lamarckii*.

Maturation and Fertilisation in Cymbulia peronii.§—A. Nekrassoff gives a detailed account of these phenomena in this Pteropod mollusc. The following are some of his results. The cleavage centrosomes arise apparently de novo, in any case not from the sperm-centrosome. The cytoplasm of the ovum influences the head of the spermatozoon, which changes its shape, shortening and rolling up. After the constriction of the second polar body, the sperm-head is attracted by the centre of the degenerating radiate system of the ovum. After the union of the sex-nuclei the sperm-nucleus behaves like the half of the nucleus of ordinary cells. It takes equal part with the ovum-nucleus in forming the achromatin figure of the karyokinesis, and provides half the number of chromosomes for the first cleavage spindle. The tail of the spermatozoon is gradually absorbed by the cytoplasm.

δ. Lamellibranchiata.

Seasonal Variations in the Glycogen made by Oysters.‖—J. A. Milroy finds that the percentage of glycogen varies to a large extent with the weight or nutritive condition of the oysters. As regards seasonal variations, there is a gradual rise in the percentage from the beginning of August until the middle or end of October. This is succeeded by a fall which reaches its minimum about the middle of December. From that period onwards the percentage rises until it reaches its maximum some time between the beginning of April and early in May. The per-

* Comptes Rendus, cxlviii. (1909) pp. 868–70. † Tom. cit., p. 956–9.
‡ Fisheries, Ireland, Sci. Invest., 1907, ii. (published 1909) pp. 1–52 (1 pl.).
§ Archiv Mikr. Anat., lxxiii. (1909) pp. 913–94 (5 pls. and 17 figs.).
‖ Fisheries, Ireland, Sci. Invest., 1907, iv. (published 1909) pp. 3–12 (7 diagrams).

centage then falls until it reaches its second minimum early in August. The fact that the variations in percentage of glycogen to a large extent run parallel with the variations in weight somewhat masks the seasonal alterations.

The results seem to indicate that glycogen is being stored from August to October, probably as a provision for a period of lessened activity of absorption during the colder months. The second rise in percentage is probably preparatory to an increased functional activity with a correspondingly increased destruction of glycogen during the hotter months of the year.

Arthropoda.

α. Insecta.

Tropisms of Insects.*—C. T. Brues points out the danger of studying responses in the laboratory without careful reference to behaviour in nature. Much is said about the negative geotropism of insects—they persistently seek the top of the jar in which they are kept captive. But this negative geotropism becomes an absurdity as soon as we attempt to apply it in a general way to insects in their natural environment. It vanishes. Crawling insects do not congregate at the tops of objects in their environment, and flying insects do not seek high altitudes. The flight of the humble-bee shows neither geotropism or phototropism, but catch it in a net and it is a marked instance of negative geotropism. There is an instinct to seek the open whenever disturbed, and this usually means flying upward and toward the light.

Bees of the parasitic genus *Cœlioxys* fly downward when caught in the net. This may be connected with its habit of entering the nests of other bees to lay its eggs. "In the event of its discovery by the rightful owner of the nest, it may drop to the ground with much better chances of escape than it would otherwise have."

Terrifying Attitude of Eyed Hawk-moth.†—Arnold Japha describes the "Trutzstellung" of *Smerinthus ocellatus*, and gives a correct figure. During the day the moths remain seated quietly on the stems of willows and other trees, or hanging from the branches. The eye-spot and the rose-red part of the wings are quite hidden, and the moth is like a group of dried willow leaves. Under stimulus it assumes instantaneously its terrifying attitude: the spot and the red are displayed, the thorax is arched up, and the abdomen curved. At the same time there is the curious energetic rhythmical movement—protruding and retracting the front of the body—which lasts for a few seconds or half a minute. Then it goes to rest again with almost imperceptibly slow change of position. Standfuss gave specimens to nightingale, red-breast, blackcap, and other birds: four out of five were obviously frightened when the terrifying attitude was assumed. They left it alone after one trial.

* Amer. Nat., xlii. (1908) pp. 297–302.
† Zool. Jahrb., xxvii. (1909) pp. 321–8 (1 pl.).

Influence of Cold and Moisture on Lepidoptera.* — Peter Kosminsky subjected pupæ of *Vanessa io*, *V. antiopa*, and *Limantria dispar*, to moist surroundings, and found that this had very little effect on coloration, marking, or scales. He subjected the same and other forms (*Malacosoma neustria* and *Arctia villica*) to moderate cold (and to moisture), and found that the scales became narrower and smaller. In cases where the temperature was not moderately low, but below zero, enlarged and broadened scales sometimes resulted, and there were interesting changes in the colouring and in the antennæ of the female of *Lymantria dispar*, which approached the male in appearance.

Papillæ on Proboscis of Lepidoptera.†—Emile Guyénot has studied these in the sub-family Nymphalinæ. They occur on the supero-external surface, either in a single row or in two rows. Some are small, some are large; some are toothed, others are not; there may be 10 or 120; in short, there is great diversity.

Abrupt Variation in Drosophila confusa.‡ — A. Delcourt reports the sudden appearance of a slight abnormality in the second transverse nervure (the appearance of a supplementary nervure) in the wing of this fly. He found it reappearing in 30–35 p.c. of the offspring.

Metamorphosis of Anterior Part of the Alimentary Canal in Muscid Larvæ.§—Charles Pérez discusses the œsophagus and the suctorial crop which is formed as a dorsal evagination of the œsophagus. In both, the wall consists of an epithelial layer enveloped by a muscular tunic. When the larva ceases to feed, the large crop contracts, its chitinous lining is crumpled up and passed out at the mouth, the muscular tunic is broken up by the immigration of phagocytes, the epithelial cells show chromatolysis in their nuclei and granular degeneration in their protoplasm, and they also become the prey of phagocytes.

In the building up of the definitive anterior region of the gut, an important part is played by the "imaginal ring" of Kowalevsky and Van Rees. It is exclusively epithelial, and the myoblasts which become associated with it migrate from a separate origin between the œsophagus and the heart.

The highly specialised organs of the larva disappear completely; the highly differentiated organs of the imago are formed altogether de novo from special histoblasts; only the somewhat indifferent regions are carried on from the larva to the imago, and even they are considerably changed.

Gastrulation in Gastroidea viridula.‖—Jan Hirschler finds that the mesenteron in this beetle has a multipolar development, arising from two endodermic, streak-like primordia, which inclose several endodermic islands. It is altogether endodermic; there is no evidence of ectodermic proliferation. The author takes a comparative survey of gastrulation in other insects.

* Zool. Jahrb., xxvii (1908) pp. 361–90 (5 pls.).
† C.R. Soc. Biol. Paris, lxvi. (1909) p. 697–9.
‡ Tom. cit., pp. 709–11 (2 figs.).
§ Op. cit., lxiv. (1909) pp. 835–6.
‖ Bull. Internat. Acad. Sci. Cracovie, 1909, pp. 284–308 (1 pl. and 2 figs.).

Study of Genus Disonycha.*—L. L. Scott has studied the Ohio species of this genus of Chrysomelid beetles. The species are notable for their power of adapting themselves to very varied environmental conditions. One of the species, *D. quinquevittata*, has been observed swarming in Arizona: an immense swarm, probably 20 or 25 ft. thick, was observed passing up the Colorado river. There was no lack of food to prompt migration, but the weather was very sultry. The author gives an account of the life-history of this species and a key to the Ohio species.

Bed Bugs.†—W. S. Patton points out that *Cimex lectularius* is the only well-known species; *C. ciliatus* Eversmann, *C. rotundatus* Signoret, and *C. macrocephalus* Fieber are very imperfectly known. He finds that *C. lectularius* is distributed chiefly throughout the temperate zones, while *C. rotundatus* is tropical or sub-tropical. It is pointed out that *C. rotundatus* is of a dark mahogany colour; its head is not as long or as broad as that of *C. lectularius*; its prothorax, which is also narrower and shorter, is rounded to the margin, and quite unlike that of *C. lectularius*, whose prothorax is raised in the centre but flattened abruptly at a line a little beyond the level of the eyes. The abdomen of *C. rotundatus* is less orbicular, and broadest at the second segment, whereas that of *C. lectularius* is broadest at the third segment. Patton finds that *C. rotundatus* may occur on the yellow bat (*Scotophilus kuhli*), which also harbours *C. pipistrelli* Jenyns.

Ovary of Rhynchota.‡—H. Wielowieyski has continued his study of the insect ovary. The primitive germ-cells of Hemiptera are contained in the so-called terminal chamber of the ovariole, where they divide in the larvæ into glandular yolk-making cells and oocytes.

Study of Leaf-insect.§—H. S. Leigh has studied the life-history of *Phyllium crurifolium*. These insects are dependent upon a very warm and moist atmosphere, and are therefore more or less confined to the islands in the tropical zone. In all stages they are very similar, both in colour and habits, to various plant-structures. Post-embryonic development is slow, and takes place by a gradual increase in size of the individual, adults only differing externally from the young in the possession of fully-developed tegmina and wings. The sexual dimorphism is pronounced, the females being large and foliaceous, whilst the males are much smaller, and although flat are not characterised by such a leaf-like appearance as the females.

β. Prototracheata.

New Species of Peripatoides.‖—Baldwin Spencer describes *P. gilesii* sp. n., from West Australia. The claw-bearing legs are 16 in number; the first and last are somewhat smaller than the others. The

* Ohio Naturalist, ix. (1909) pp. 423–30 (4 figs.).
† Records Indian Museum, ii. (1908) pp. 153–5 (1 pl.).
‡ Bull. Internat. Acad. Sci. Cracovie, 1908, pp. 353–9 (3 pls.).
§ Proc. Zool. Soc., 1909, pp. 103–13 (1 pl.).
‖ Proc. R. Soc. Victoria, xxi. (1909) pp. 420–2.

first jaw is simple in all the specimens, there being no trace of any accessory tooth; the second jaw has four clearly-marked teeth and one minute accessory tooth. In the number of legs and the structure of the jaws *P. gilesii* differs from all other Australasian species of either of the genera, *Peripatoides* or *Ooperipatus*.

γ. Myriopoda.

Studies on Centipedes.*—F. Silvestri continues his investigations on Chilopoda. He gives descriptions of some genera and species of Henicopidæ, including *Lamyctinus* g. n., *Esastigmatobius* g. n., and of some genera and species of Geophilomorpha, including species of *Aphilodon*, *Mecophilus*, and *Apogeophilus*.

Ethiopian Myriopods.†—Carl Graf Attems reports on a collection from "a region which has been but little explored in this connection." The collection includes twenty species, of which seven are new, e.g. *Amurus drepanopus*, *Oxydesmus anacanthus*, *Lissopyge neumanni*, and *Obelostreptus acifer*.

Abnormal Pair of Appendages in Lithobius.‡—L. Doncaster calls attention to the occurrence of an extra pair of appendages between the poison-claws and the second maxillæ. The mandibles and both pairs of maxillæ appeared to be perfectly normal, and behind the normal pair of poison-claws there were as usual fifteen pairs of walking-legs. The extra appendages were more nearly like poison-claws than any other appendages of *Lithobius*, but differed in several important details.

δ. Arachnida.

Vagina of Lycosidæ.§—T. H. Järvi notes that it is customary to regard the "epigyne" in Lycosid spiders as a median "groove," in various ways divided by a median septum. He sees in the epigyne two paired integumentary furrows, which start from the anterior margin of the vaginal opening and run forwards. The furrows are continued for a very short distance into the delicate chitinous ventral (anterior) wall of the vagina. In Lycosidæ the primitive type of epigyne is marked by a superficial pair of furrows extending forwards from the margin of the vaginal opening. They are really to be regarded as derivatives of the openings of the receptacula. Starting from this interpretation, the author makes a scheme suggesting the probable evolution of the various types of vaginæ in Lycosidæ.

Oriental Solifugæ.‖—A. S. Hirst describes a number of new species of *Galeodes* from the Indian Museum—*G. aulicus*, *G. festivus*, *G. annandalei*, etc., and *Eusimonia celeripes*, also new. He gives a useful key showing the principal differences between the males of the species of *Galeodes*.

* Boll. Lab. Zool. Scuola Agric. Portici, iv. (1909) pp. 38–65 (16 figs.).
† Zool. Jahrb., xxvii. (1909) pp. 390–418 (1 pl. and 3 figs.).
‡ Proc. Cambridge Phil. Soc., xv. (1909) pp. 178–9 (2 figs.).
§ Zool. Anzeig., xxxii. (1908) pp. 754–8 (14 figs.).
‖ Records Indian Museum, ii. (1908) pp. 241–7 (1 fig.).

Monograph on Ixodoidea.*—G. H. F. Nuttall and C. Warburton, assisted by W. F. Cooper and L. E. Robinson, have begun a very welcome finely illustrated monograph on Ixodoidea. Part 1. deals with the Argasidæ, their classification and destinctive features, the genera *Argas* and *Ornithodoros*, and their numerous species. The authors discuss also the œcology of the Argasidæ, the effects of their bites, their relation to the spread of disease, and the like.

ε. Crustacea.

New Schizopods from Alaska.†—A. E. Ortmann describes among other forms a new genus *Holmesiella*, which necessitates a change in the definition of Leptomysinæ. The chief character of the genus is the elongation of the inner ramus of the fourth pair of pleopods in the male.

New Species of Grandidierella.‡—T. R. R. Stebbing describes a new species of this interesting genus, which was established by Coutière in 1904 for *Grandidierella mahafalensis* from a salt lake in Madagascar. Professor Coutière expressed an expectation that marine examples of his singular new species would be forthcoming on the west coast of Madagascar. This discovery has apparently not been made, but what has actually happened is perhaps of even greater interest. A closely related species—*G. bonnieri* sp. n.—is now described by Stebbing from brackish ponds in Lower Bengal. "Their differences may be considered to prove that the two species have been for a long time isolated one from another. Yet, whatever the interval in chronology, the vast intervening space of ocean has left unobliterated and in fact unobscured the evidence of a common ancestry."

Caridina nilotica and its Varieties.§—J. G. De Man makes a detailed study of this Atyid Crustacean, which has nine varieties—the differences relating mainly to the teeth on the rostrum, and to the proportions and spines of the thoracic legs. By means of abundant measurements he has been able to introduce order into the species *Caridina nilotica* Roux.

Monograph on Swiss Isopods.‖—Joh. Carl has done an admirable piece of work in his monograph on Swiss Isopods. He gives an account of each species, with much interesting information as to habits and distribution. He has added eighteen species or varieties to the Swiss list, including three new species and five new varieties. The list now stands at forty-two in all. In general, the Isopod fauna of Switzerland is like that of Central and North Europe, but there is an interesting mingling with southern species.

Leidya distorta.¶—Harriet Richardson gives a description of this curious Isopod, which Leidy recorded as parasitic on *Uca pugilator*,

* Ticks: a Monograph of the Ixodoidea. Part I. The Argasidæ. Cambridge, 1908, xxxv. and 104 pp. (3 pls. and 114 figs.).

† Proc. U.S. Nat. Museum, xxxiv. (1908) pp. 1–10 (1 pl.).

‡ Records Indian Museum, ii. (1908) pp. 119–23) 1 pl.).

§ Tom. cit., pp. 255–83 (1 pl.).

‖ Neue Denkschr. Schweiz. Nat. Ges., xlii. (1908) pp. 113–242 (6 pls.).

¶ Proc. U.S. Nat. Museum, xxxiv. (1908) pp. 23–6 (5 figs.).

which has now been obtained from the branchial cavity of *Pachygrapsus transversus*. The young female is described and figured for the first time. The contrast between the narrow elongate male and the oblong oval adult female is striking.

New Amphipod from Costa Rica.*—T. R. R. Stebbing describes a new Talitrid species, *Orchestoidea biolleyi* sp. n. The genus *Orchestoidea* Nicolet agrees with both sexes of *Talitrus* and with the female of *Talorchestia* in having the first gnathopod simple, differing from the male of *Talorchestia* and both sexes of *Orchestia*, in which the first gnathopod is subchelate.

Spongicolous Crustaceans.†—J. F. McClendon has studied at Tortugas *Synalpheus lævimanus longicarpus* Herrick, which lives in great abundance in the cavities of the loggerhead sponge. In the sponge there are also some Amphipods, which go deeper, and undetermined Potoniids which resemble the Alpheids in size and shape and have very similar habits. Whereas *Alphæus* has the first pair of thoracic legs greatly and asymmetrically developed, the same is true of the second pair of thoracic legs in the Potoniid. In both animals the largest claw can be closed with such rapidity and force as to produce a loud snapping sound. It is probable that the large claw is for defence, and that the animal feeds on the sponge or on the food swept in. The resemblance between the Alpheids and the Potoniids is probably rather one of convergence than of protective mimicry.

Sacculina on Shore-crab.‡—F. A. Potts points out that while Oxyrhyncha are sterilised completely by *Sacculina*, the common shore-crab (*Carcinus mænas*) when attacked by the same parasite offers a case of slight or incipient modification. Details are given of the change in the abdomen of the male, which becomes broader (more female-like) and has the lost jointing between the third, fourth, and fifth segments re-established. There was no diminution in size of the copulatory styles and no appearance of the abdominal swimmerets which are characteristic of the female. In the female no change was ever detected in the abdomen as the result of parasitism. The effect on the gonads is slight—the most noticeable change being the failure of the female to produce large heavily-yolked eggs. The testes continue to produce spermatozoa and the ducts are filled with spermatophores. The case of *Carcinus* may be compared with that of the "stylopised" males of bees (*Andrena*) which undergo considerable external change, but the testis of one side remains fully developed and functional. The prevention of moulting is regarded as due to a mechanical disability, the *Sacculina* acting as a rivet and preventing the fleshy part of the abdomen from being withdrawn from its chitinous base.

Alimentary Canal and Food of Copepoda.§—W. J. Dakin has studied a number of common marine Copepods. He finds that the

* Proc. U.S. Nat. Museum, xxxiv. (1908) pp. 241–4 (1 pl. and 2 figs.).
† Carnegie Inst. Washington, Yearbook No. 7 (1908) p. 128.
‡ Proc. Cambridge Phil. Soc., xv. (1909) pp. 96–100 (2 figs.).
§ Internat. Rev. Hydrobiolog., i. (1908) pp. 772–82.

alimentary canal contains in most cases a green mass, with or without siliceous remains. The food consists of Diatoms and Dinoflagellates, and chiefly of the smaller species. In addition to these the source of the green substance often seen is probably to be found in the extremely minute Protophyta which pass through "Müllergaze No. 20," and occur in great numbers in the sea. Other small organisms, such as Silicoflagellates, occasionally occur. A certain relation seems to exist between the times of maxima of the Copepods in the sea and the maxima of the phytoplankton. It may be that these directly affect one another, or both may be conditioned by other causes at present unknown.

Summer Resting Stage in Cyclops bicuspidatus.*—E. A. Birge and C. Juday found numerous oval cysts at the bottom of six Wisconsin lakes. Each cyst contained a fully formed but immature *Cyclops*, which was surrounded by a capsule of cement and detritus with only the abdominal setæ projecting. The Entomostraca emerged in the laboratory. It is not at present possible to correlate this resting-stage, which lasts for four months or so, till the middle of October, with any physical change in the lake, and it seems only to affect certain individuals of the species.

Entomostraca from Tripolis and Barka.†—V. Brehm reports on a collection of three Cladocera, three Copepods, and two Ostracods, the interest of which is that they belong to Mediterranean, not to purely African, genera. The Sahara is the faunistic boundary, not the Mediterranean. The Copepods are (1) *Cyclops prasinus*, mostly confined to warm water in the south of Europe; (2) a variety *hyalina* of *C. oithonoides*; and (3) *Wolterstorffia confluens*, previously known from Holstein.

Tanganyika Copepods.‡—G. O. Sars reports on a collection made by W. A. Cunnington, 38 species in all, in the genera *Diaptomus*, *Schizopera*, *Ilyophilus*, *Cyclops*, *Ergasilus*, and *Ergasiloides* g. n. Of these 38 species the great majority, namely, 30, are new to science, and of the genera two have been previously known only from salt or brackish water, viz., *Schizopera* and *Ilyophilus*. From Lake Tanganyika 29 species were obtained, from Nyasa 11, from Victoria Nyanza only 7. There seem to be no Cladocera in Tanganyika, while in the other two lakes there are several limnetic and bottom forms. Distinct species of *Diaptomus* occur in the three lakes. Twelve endemic species of *Cyclops* occur in Tanganyika.

As to *Schizopera* and *Ilyophilus*, Tanganyika has *Ilyophilus perplexus*, and seven species of *Schizopera*; there is one species of *Schizopera* in Nyasa alone and another in Victoria Nyanza (shared with Tanganyika). Sars does not regard these as "halolimnic" (relict) forms, but as originally derived from forms accidentally transported by the aid of migratory aquatic birds. Perhaps *I. perplexus* has evolved from *I. flexilis*, and the seven Tanganyika species of *Schizopera* from the type species, *S. longicauda*.

* Trans. Wisconsin Acad. Sci., xvi. (1908) pp. 1–9.
† Zool. Jahrb., xxvi. (1908) pp. 439–45 (1 pl.). See also Zool. Zentralbl., xv. (1908) p. 577.
‡ Proc. Zool. Soc., 1909, pp. 31–77 (18 pls.).

Annulata.

Change of Sex in Ophryotrocha puerilis.*—F. Braem halved a female with ripe eggs. The head portion with thirteen segments was isolated. In three weeks it had regenerated seven segments with parapodia. It was then killed, and found to be male. The ova had disappeared from the gonads, leaving only a residue, and a functional testicular portion had developed, and was producing spermatozoa. Braem thinks that in consequence of the amputation the very young, indifferent germ-cells had developed into male cells, which require less subsistence than ova. There was no trace of hermaphroditism to start with. What is certain is that the gonads changed from producing eggs to producing sperms.

Artificial Parthenogenesis in Aricia.†—K. Kostanecki subjected eggs of this Annelid for a short time to acid solutions (acetic or nitric), and then to hypertonic solutions. A certain number of the eggs segmented into three or four blastomeres, and a few reached the six- or eight-cell stage.

Littoral Polychæta of Torquay.‡—E. V. Elwes reports on Phyllodocidæ, Nephthyidæ, Hesionidæ, and Nereidæ collected at Torquay, and gives a useful key to the genera found on the French and English coasts of the Channel.

Development of Echiurus.§—W. Salensky continues his study of the development of the larva of *Echiurus*, giving particular attention to the differentiation of the mesoblast and mesenchyme, and the formation of the food-canal.

Mediterranean Chætognatha.‖—R. von Ritter-Zahony deals with the Chætognatha of the Eastern Mediterranean. He pays particular attention to the question of vertical distribution, to the classification, and to the detailed structure of the head. Details are given as to the muscular strands, the teeth and the hooks, the nervous system, and the gonads.

Australasian Oligochæta.¶—E. J. Goddard describes from New South Wales two species of a new genus—*Astacopsidrilus*—of fresh-water Oligochæta. The specimens were found in association with the large crayfish (*Astacopsis serratus*). The new genus resembles *Phreodilus* Beddard and *Phreodriloides* Benham in general characters, but differs from them in having spermathecal structures in the 14th segment, almost devoid of musculature, without direct openings to the exterior, but communicating with ovisacal structure in the 13th segment.

The author also describes** immature specimens of a Tasmanian worm not unlike *Phreodrilus maniensis*.

* Anat. Anzeig., xxxiii. (1908) pp. 19–27 (2 figs.).
† Bull. Internat. Acad. Sci. Cracovie, 1909, pp. 238–53 (16 figs.).
‡ Journ. Mar. Biol. Assoc., viii. (1908) pp. 347–58.
§ Bull. Acad. Imp. Sci. St. Pétersbourg, sér. 6, i. (1909) pp. 363–80 (11 figs.).
‖ Denkschr. Math. Nat. Klasse Akad. Wiss. Wien, lxxxiv. (1908) p. 1–18 (1 pl.).
¶ Proc. Linn. Soc. N.S. Wales, xxxiii. (1909) pp. 768–93 (3 pls.).
** Tom. cit., pp. 845–53.

Vascular System of Oligochæta.*—S. Sterling has studied this in *Sterrutus niveus*, *Euenchytræus bisetosus*, *Eisenia* (*Allolobophora*) *fœtida*, *Pheretinia rodericensis*, and other forms.

The ventral vessel arises as a space between the endoderm and the still unsplit mesoderm. As the latter becomes more differentiated the space is gradually surrounded by splanchnopleure cells. These mesodermic cells form the future walls of the vessels.

The two lateral vessels arise in the same way as lateral clefts. They are more dorsalwards in the anterior region and form the dorsal vessel.

The intestinal vascular plexus (or sinus) arises subsequently from numerous longitudinal and circular clefts, whose walls are due to the splanchnopleure.

The septal vessels lie first in the intersegmental cavities, which communicate with the space of the ventral vessel. The nephridial vessels seem to arise in close connection with the interseptal cavities. The typhlosole vessel is in close connection with the dorsal vessel and the sinus.

The subneural vessel arises as a gap between the two halves of the nerve-cord on the ventral side, and its walls arise from immigrant mesoderm cells.

The chloragogen is formed by differentiation of splanchnopleure cells. The cells in the blood are hæmocytes, of mesenchymatous origin, and multiply mitotically. The valves and vasochords are "exotropic" structures, which arise very early in the lumina of the vessels, and have an important mechanical function.

In lower Oligochæta the intestinal sinus is a space between the intestinal epithelium and the musculature. It is lined by a homogeneous membrane, lying directly on the circular muscle-layer. The dorsal vessel has in its anterior an intima, corresponding to the basal membrane of the sinus; outside this there is longitudinal muscle, circular muscle, and chloragogen. The internal cells in the hearts, often called muscular, are amœboid. The dorsal vessel has in its anterior region a vasochord, probably mechanical in its function. In the ventral vessel and the lateral vessels there is much the same structure as in the dorsal.

In the higher Oligochæta, if there is an intestinal blood-sinus, it has a basal membrane, but no vasothelium; where there is a vascular network instead of a sinus, the vessels have the same walls as in other parts of the system. The (contractile) dorsal vessel is lined by an intima, outside which there is longitudinal muscle, circular muscle, and peritoneum. The lateral hearts have the same structure. The (slightly contractile) ventral vessel has an intima and a strong circular muscle-layer. In some species there is a weak longitudinal muscle-layer. In the dorsal and ventral vessels the musculature is imbedded in connective-tissue, often strongly developed. There is no vasothelium, but blood-cells are often lying against the walls in the larger vessels.

Amœbocytes of Lumbricus.†—H. Joseph has made a detailed study of these elements, but we cannot do more than refer to the main con-

* Jen. Zeitschr. f. Naturw., xliv. (1909) pp. 253–352 (9 pls. and 16 figs.).
† Arbeit. Zool. Inst. Univ. Wien, xviii. (1909) p. 1–60 (3 pls. and 30 figs.).

clusion that the central structures in these elements are comparable to centrioles. They are extraordinary in their large size, and in the variability of their size, for dimensions of 4 μ–1 μ or less are recorded.

Indian Oligochæta.*—W. Michaelsen gives an account of a large collection from India, Nepal, Ceylon, Burma, and the Andaman Islands. He distinguishes limnic Oligochætes mostly belonging to the archaic families of Æolosomatidæ and Naididæ, one littoral form *Pontodrilus insularis* Rosa, from Ceylon, and the terrestrial forms which make up the bulk of the collection. Among these he distinguishes the endemic species from the "peregrine" species distributed by man. There is a fine discussion of the geographical distribution and its bearing on geological history.

J. Stephenson † gives an account of the structure of several fresh-water forms belonging to the genera *Nais*, *Pristina*, *Slavina*, and *Stylaria*. He calls attention to the very variable thorn-like projections on the dorsal setæ of several forms, to the probable sensory function of the dorsal setæ of the third segment of *Pristina longiseta*, and to the variations in the length of the prostomium in *Pristina*. There is an "antiperistaltic" action and reversed ciliary current in the intestine of these aquatic forms, and this has probably a respiratory significance. It is pointed out that sexual and asexual reproduction may occur concomitantly in *Nais variabilis*.

Fresh-water Oligochæta.‡—W. Michaelsen gives a very useful and very welcome guide to the study of the fresh-water Oligochæta of Germany.

Fresh-water Hirudinea.§—L. Johansson gives an account of the fresh-water leeches of Germany, which will be of much service to students of the fresh-water fauna.

New Australian Leech.‖—E. J. Goddard describes *Dineta cylindrica* g. et sp.n. from New South Wales. Its general appearance is not unlike that of *Orobdella*, and its structure is nearest that of *Dina*.

Minute Structure of Vascular System in Branchiobdella.¶—Fr. Bilek has studied this in *B. parasita* Henle, with special reference to the "vasochord" found in the intestinal sinus and in the dorsal blood-vessel. It seems that vasochord, sinus, and vasothelium must be referred to an endodermic origin. In its youngest stages the vasochord is seen in direct connection with the intestinal epithelium, differentiating from the supplementary cells. The vasochord was probably a mechanical function, securing that the lumen of the heart is narrowed as much as possible during contraction, and to some extent compensating for the absence of cardiac valves in *Branchiobdella*.

* Memoirs Indian Museum, i. (1909) pp. 103–253 (2 pls.).
† Tom. cit., pp. 255–81 (6 pls.).
‡ Die Süsswasserfauna Deutschlands. Herausgegeben von A. Brauer. Heft 13 (Jena, 1909, pp. 1–66 (112 figs.). § Tom. cit., pp. 67–84 (32 figs.).
‖ Proc. Linn. Soc. N.S.W., xxxiii. (1908) pp. 854–66 (2 pls.).
¶ Zool. Anzeig., xxxiii. (1908) pp. 466–73 (4 figs.).

Nematohelminthes.

Australian Endoparasites.*—Georgina Sweet gives a list of the various Trematodes, Cestodes, Nematodes, Insects, and Arachnids that have been recorded as endoparasites in Australian stock and native fauna. She adds a number to the list, e.g. *Triodontophorus intermedius* sp. n. and *Ascaris marina* (Linn.).

Fresh-water Nematodes.†—L. A. Jägerskiöld gives an account of the free-living Nematodes in fresh-water in Germany—a study hitherto very baffling because of the scattered literature. Not less welcome is Dr. v. Linstow's guide to the parasitic Nematodes. R. Hartmeyer deals with four species of *Mermis* and with the Gordiidæ.

Indian Gordiacea.‡—L. Camerano reports on the Gordiacea in the Indian Museum, Calcutta, and describes three new species: *Chordodes annandalei* from a *Mantis*, *Ch. giglio-tosi*, and *Gordius zavatarii.*

Platyhelminthes.

Endoparasites of Fishes.§—Jas. Johnstone describes the Cestode *Dibothrium crassiceps* from a hake, the Trematode *Zoogonoides viviparus* from a plaice, a hake with egg-like bodies in its muscles, and two plaice with tumours.

New Davaineidæ.‖—O. Fuhrmann continues his researches on the Cestodes of birds, and describes a large number of new forms: 28 new species of *Davainea*, 4 of *Cotugnia*, and 1 of *Idiogenes*.

Structure and Classification of Digenetic Trematodes.¶—W. Nicoll discusses the difficulty of classifying Trematodes, and describes in a very thorough way a number of new forms. In the new sub-family Stephanophialinæ he erects a new genus *Stephanophiala* with *S. laureata* Zeder as type; in the sub-family Brachycladiinæ, *B. oblongum* Braun is discussed; in the sub-family Allocreadiinæ, *Lebouria idonea* g. et sp. n. is described and *Podocotyle atomon* Rud. The classification of the Allocreadiinæ with its six genera is discussed. In the new sub-family Fellodistominæ Nicoll describes *F. fellis* Olsson, *F. agnotum* sp. n., and *Steringophorus cluthensis* sp. n.; in the sub-family Plagiorchinæ he describes *P. notabilis* sp. n. from the rock pipit.

New Species of Chiorchis.**—Th. Barrois describes *Chiorchis noci* sp. n., found by Dr. Noc in the cæcum of *Macacus cynomolgus*. Only one other species of this remarkable genus of Cladorchinæ is known, that described by Diesing (under the name of *Amphistomum fabaceum*)

* Proc. R. Soc. Victoria, xxi. (1909) pp. 454–528 (1 pl.).
† Die Süsswasserfauna Deutschlands. Herausgegeben von A. Brauer. Heft 15 (Jena, 1909) pp. 1–92 (155 figs.).
‡ Records Indian Museum, ii. (1908) pp. 113–17.
§ Report Lancashire Sea-fisheries Laboratory, xvii. (1909) pp. 87–100 (2 pls. and 4 figs.).
‖ Centralbl. Parasitenk., xlix. (1909) pp. 94–124 (44 figs.).
¶ Quart. Journ. Micr. Sci., liii. (1909) pp. 391–487 (2 pls.).
** C.R. Soc. Biol. Paris, lxiv. (1908) pp. 791–3.

from the intestine of manatees. We may refer to one of the points noted. It is in regard to the way in which these parasites attach themselves to the mucous membrane of the cæcum. The ventral sucker has such energetic suctorial power that the mucosa forms a sort of hernia into the interior of the sucker and completely fills it.

Incertæ Sedis.

Weldonia parayguensis.*—C. H. Martin describes an animal superficially like *Microstoma lineare*, but which could not be satisfactorily referred to any accepted group of Turbellaria. Each consists of two or three zooids, one behind the other. A large mouth opens into a pharynx, with complicated folds; then follows an intestinal region; there is no trace of an anus. A very interesting feature is a deep groove along the whole length, above the nerve-cord. The nerve-cord during the greater part of its length consists of a much flattened tube. At the anterior end of each individual the nerve-cord turns upwards and comes into contact with the wall of the neural groove. It also gives rise by short lateral stalks to two large ganglia, which surround on each side a sensory invagination of the epidermis lying on the neural side of the pharynx. The pharynx of the younger buds is found on the apo-neural side of the animal, as an inpushing of the epidermis, which in later buds comes into communication with the intestine on its apo-neural side. Against any close connection with Turbellarians the author notes the presence of a cuticle, the apparent absence of cilia, the relations and structure of the nervous system. Perhaps, he says, there is some approach to an extremely early Chordate.

Rotifera.

Parasitic Rotifer in Rhizopod.†—E. Penard gives a description and figure of *Proales latrunculus* sp. n., which lives parasitically within and on the Heliozoon *Acanthocystis turfacea*. The small Rotifer, about 90 μ in size, allows itself to be ingulfed in the usual Rhizopod fashion by its unsuspecting host, but no sooner has the envelope closed upon the Rotifer, than it expands its ciliary wreath and proceeds to eat up everything it can find in the larder, then it attacks the protoplasmic walls and feeds on these. A terrible struggle now goes on between the host and its prey, which usually lasts about six hours and nearly always ends with the death of the Rhizopod. When the *Proales* has fed sufficiently and *Acanthocystis* has given up the struggle, it begins to lay eggs, one to three in number, and then it seems to consider that it is time to get out of its prison, for it proceeds to push, bite and hammer at a selected spot until the thick wall and plates give way and the little Rotifer can escape in the open. The eggs mature in about 24 hours and the young escape through the opening made by the parent, in order to repeat this remarkable life-history. In the summer of 1904 Dr. Penard found nearly half of all the *Acanthocystis turfacea* afflicted with this parasite, a regular plague for these Rhizopods.

* Zool. Anzeig., xxxii. (1908) pp. 758–63 (5 figs.).
† Mikrokosmos, ii. (1909) pp. 135–143 (7 figs.).

New Indian Phylactolæmata.*—N. Annandale describes *Plumatella bombayensis* sp. n. and *Pectinatella burmanica* sp. n., the latter being established on the statoblasts only, which were found attached to the protective tube of the Oligochæte worm *Aulophorus tongkinensis*, a most industrious collector of gemmules and statoblasts.

Brachiopods from Bay of Biscay.†—A. Reynell notes that the 'Huxley' collected in 1906 from the north side of the Bay of Biscay the following three species—*Magellania cranium* Müller, *M. septigera* Lovén, and *Mühlfeldtia truncata* Linné. The last is probably a new record, Turton's Torbay locality being very doubtful.

Echinoderma.

Cross-fertilised Echinoid Ova.‡—D. H. Tennent has made sections of *Toxopneustes variegatus* eggs fertilised with the sperm of *Moira atropos* (a Spatangoid), and of *Arbacia punctulata* eggs fertilised with *Moira* sperm. The results of the study may be summarised as follows :—The equatorial plate of the *Moira-Toxopneustes* cross shows a mixture of two kinds of chromosomes not sufficiently unlike one another to enable a positive distinction between the two to be drawn. (2) The equatorial plate of the *Moira-Arbacia* cross shows a mixture of two kinds of chromosomes, one variety long, the other variety short. These differences in form are correlated with the spermatozoon and the egg respectively.

Regeneration in Ophiuroids.§—C. R. Stockard, who has made many interesting experiments on Medusæ, has also worked with *Ophiocoma riisei* and another Ophiuroid. Both species regenerate their arms more rapidly when cut close to the disk than when cut at greater distances away. The deeper the level of the cut the more rapidly will the ensuing regeneration take place. Individuals of both species were selected and divided into groups, from which different numbers of arms were removed, all arms being cut at a distance of 1 cm. from the disk ; *O. riisei* regenerated its arms at rates entirely indifferent to the degree of injury inflicted ; the other (undetermined) species regenerated its arms fastest when few had been removed, and distinctly slower when many had been removed. Starfish, with five arms cut off, regenerated only three-fourths as rapidly as those with one arm removed. These results are the opposite of those obtained from Medusæ.

New Crinoids.—A. H. Clark‖ describes, in the first place, two new Stalked Crinoids from the Eastern coast of North America,—*Bathycrinus serratus* sp. n., and *Rhizocrinus verrilli* sp. n.

He goes on ¶ to describe twenty-four new species of free Crinoids, chiefly from the Hawaiian Islands, "a collection of very exceptional interest, quite as much through the forms which are lacking as through

* Records Indian Museum, ii. (1908) pp. 169–74 (5 figs.).
† Journ. Mar. Biol. Assoc., viii. (1909) pp. 392–3.
‡ Biol. Bulletin, xv. No. 3 (1908) pp. 127–34 (1 pl.).
§ Carnegie Inst. Washington, Yearbook No. 7 (1908) p. 131.
‖ Proc. U.S. Nat. Museum, xxxiv. (1908) pp. 205–8 (3 figs.).
¶ Tom. cit., pp. 209–39.

those included." The four families represented are all of very wide distribution; the types are all deep-water types. The Crinoid fauna of the Hawaiian Islands is "tropical oceanic; that is, composed of genera which are certain to be found in all tropical or sub-tropical isolated islands, with a slight West Indian and somewhat stronger Indo-Japanese tinge." The author briefly discusses the recent Comatulids, and gives a key to their families.

Abnormal Arm-structure in Crinoids.*—A. H. Clark puts on record a number of cases which have recently come under his observation, e.g. six arms in *Rhizocrinus lofotensis*, a third costal intercalated between the normal two on one of the rays of *Pœcilometra acœla*, two costal series in one inter-basal area in *Heliometra maxima*.

Genus Eudiocrinus.†—A. H. Clark emends the definition of the genus *Eudiocrinus*, which belongs to the family Zygometridæ, and includes *E. indivisus* (Semper), *E. granulatus* (Bell), and *E. variegatus* sp. n., here described. A family Pentametrocrinidæ is proposed for the two genera *Pentametrocrinus* (which includes five species formerly referred to *Eudiocrinus*) and *Decametrocrinus*.

Japanese Comatulids.‡—A. H. Clark reports on a small collection which includes *Comaster imbricata* sp. n., *Thalassometra komachi* sp. n., *Eudiocrinus variegatus*, and the remarkable *Tropiometra afra*, the Japanese specimens of which closely resemble those from Australia.

Cœlentera.

Crawling Sea-anemone.§—J. F. McClendon describes a species of *Cradactis* from Tortugas which is able to crawl on its tentacles. Outside the ordinary tentacles it has branched tentacle-like structures or "fronds," which look like sea-weed. The fronds contract at night, they have nematocysts and mucus glands, but they do not carry food to the mouth as the true tentacles do. When a bit of crab-meat is placed on the end of a tentacle it adheres, and several tentacles combine to place it on the mouth. Filter paper placed on the middle of the tentacles or on the disk is sometimes swallowed, but not when placed on the tips of the tentacles. It is disgorged within ten minutes. Indian ink shows ciliary currents running toward the tips of the tentacles and fronds, and on the disk toward the mouth. The animal is disturbed by light falling on its base, and may move a short distance with snail-like movements. But soon the tentacles catch hold of the substratum on all sides, and with considerable writhing the anemone loosens the base and walks on its tentacles in an inverted position to a new place, where it rights and attaches itself. Another reef anemone, *Stoichactis helianthus*, was found to crawl with snail-like movements similar to those of *Metridium*.

Indian Ocean Fungiidæ.||—J. Stanley Gardiner revises the genera of Fungiidæ, namely *Fungia*, *Halomitra*, *Döderleinia* g. n., *Herpolitha*,

* Proc. U.S. Nat. Museum, xxxiv. (1908) pp. 265–70 (5 figs.).
† Tom. cit., pp. 271–9 (11 figs.). ‡ Tom. cit., pp. 305–19.
§ Carnegie Inst. Washington. Year-book No. 7 (1908) pp. 127–8.
|| Trans. Linn. Soc. (Zool.) xii. (1909) pp. 257–90 (7 pls.).

Polyphyllia. He deals with 26 species from the Indian Ocean. The characters of the new genus are as follows :—The corallum is thick and heavy, free, disk-like when young, getting arched later. Its wall is porous, freely so near the edge, filling up in the centre. It commences with a central calicle, but commonly breaks up as it enlarges, each fragment regenerating its corallum. Such growths are irregularly covered with calicles, each with 6 to 12 distinct septa. The costæ are low, distinct at least at the edge, subequal in size, set with low rounded spines all clearly and crowdedly granulated. The septa are alternately large and small, the latter being thinner and lower; they are much granulated all over, and the largest end in blunt denticulations.

Indian Ocean Antipatharians.*—C. Forster Cooper reports on a collection, and discusses the value of the various characters used in distinguishing species. The mode of growth is modifiable, the spines are variable, the shapes of the polyps do not help much. The author describes the following new forms :—*Stichopathes longispina*, *S. alcocki*, *S. regularis*, *S. seychellensis*, *S. bournei*, *Aphanipathes* (?) *somervillei*, *Aphanipathes* (?) *hancocki*, *Antipathes* (?) *heterorhodzos*, *Antipathes sealarki*, *A. plana*, *A. irregularis*. He changes *Antipathes gracilis* Thomson and Simpson (which is not the same as *A. gracilis* Gray) into *A. herdmani* n. n.

Japanese Pennatulids.†—H. Balss reports on an interesting collection of Pennatulids from Japan, which includes a number of forms previously known only by a single 'Challenger' specimen. The occurrence of North Atlantic and of Indo-Pacific forms is noteworthy. Balss describes *Lituaria habereri* sp. n., *Stachyptilum dofleini*, *Pteroeides dofleini* sp. n. He makes a new genus, *Prochunella*, for "*Protocaulon indicum*" Thomson and Henderson, and for *Prochunella hertwigi* sp. n. Jungersen has shown that Kölliker's *Protocaulon* was simply a young *Virgularia*.

Japanese Gorgonids.‡—W. Kükenthal communicates a second large memoir, very finely illustrated, on Japanese Gorgonids of the families Plexauridæ, Chrysogorgiidæ, Melitodidæ, and Acanthogorgiidæ. He describes eight new species of *Euplexaura*, two of *Eunicella*, five of *Chrysogorgia*, three of *Melitodes*, five of *Acabaria*, and three of *Acanthogorgia*. He also defines a new genus *Paraplexaura* made for certain species of *Plexauroides* and partly for new species, and another new genus *Anthoplexaura* for a remarkable form *A. dimorpha*. The colony is somewhat bushy; the polyps are very large, free from spicules, retractile in high calyces; the cortex is very thick; the axis is horny with some lime, very thin and flexible in the twigs; the spicules are thick warty spindles.

Alcyonarians from Hawaiian Islands.§—Charles C. Nutting has found in this region a field hitherto ungleaned as regards Alcyonarians.

* Trans. Linn. Soc. (Zool.) xii. (1909) pp. 301–21 (1 pl. and 17 figs.).
† Zool. Anzeig., xxxiv. (1909) pp. 423–31 (3 figs.).
‡ Abh. k. Bayer. Akad. Wiss., Suppl. Bd., 1909, pp. 1–78 (7 pls. and 94 figs.).
§ Proc. U.S. Nat. Museum, xxxiv. (1908) pp. 543–601.

Of 68 species collected by the 'Albatross,' 39 are new. There are no Gorgonids in the collection, few Briareids, but a surprisingly rich representation of Primnoidæ. The author finds the mode of growth of the genera *Cornularia* and *Telesto* united in one specimen (*Clavularia spiculicola* sp. n.), and he unites *Telesto* with *Clavularia*, a proceeding which will require to be justified by more evidence than is here given. He establishes a new Pennatulid genus, *Calibelemnon*, with large polyps, usually in opposite pairs, "a link in a chain of intergradation between Kophobelemnonidæ and Umbellulidæ." Another new genus is *Cyclomuricea*, with a flabellate colony, with short, stout, columnar calyces, their walls with spicules (warty spindles) in annuli.

Alcyonarians of Tadjourah.*—Ch. Gravier gives an account of a collection of Alcyonarians from the Gulf of Tadjourah, which shows a certain mingling of Red Sea and Indian Ocean species. He describes a number of new forms :—*Sarcophytum mycetoides* sp. n., *Dendronephthya formosa* sp. n., *D. kükenthali* sp. n., *Mesobelemnon gracile* g. et sp. n., *Scytaliopsis djiboutiensis* g. et sp. n. Gravier's genus *Mesobelemnon* is closely allied to *Kophobelemnon* and *Sclerobelemnon* (if these are really separate), while *Scytaliopsis*, though very Virgularid-like, is regarded as worthy of a separate family. There is much valuable detail as to the structure and mode of life of the forms described, and the illustrations are of a very high order.

Eurhamphæa vexilligera.†—C. N. Jonesen describes this rare and imperfectly known Mediterranean Ctenophore. It may be regarded as in some respects a transition form between *Bolina* and *Eucharis*.

Regeneration in a Medusa.‡—C. R. Stockard has made a large number of experiments on *Cassiopea xamachana*. The rate of regeneration in both directions towards the periphery and towards the disk centre varies according to the level of the cut. Small cross-cut strips, as well as triangular and V-shaped pieces of the disk, show great regulatory ability. Such pieces will invariably form circular bodies in the most direct manner. Such small circular bodies pulsate and act very much as an entire medusa disk would.

The rate at which *Cassiopea* regenerates its oral arms varies directly with the number of arms removed ; the more arms cut away the more rapidly will each arm be replaced.

None of the specimens were fed during the regeneration of arms, and all decreased considerably in size. Those which had lost eight arms decreased twice as much as did those from which only one arm had been removed. It looks as if the regenerating tissue had the power to grow at the expense and actually to the exhaustion of the original body tissues.

Migration of Thread-cells of Mœrisia.§—C. L. Boulenger finds that the nematocysts among the endoderm cells of the manubrium are in

* Arch. Zool. Expér., viii. (1908) pp. 179–266 (7 pls.).
† Jen. Zeitschr. Naturw., xliii. (1908) pp. 685–91 (1 pl. and 2 figs.).
‡ Carnegie Inst. Washington Year-book, No. 7 (1908) pp. 130–1.
§ Proc. Cambridge Phil. Soc., xv. (1909) p. 180.

process of migration through the tissues, a phenomenon similar to that recently described by Hadzi in hydroids. The main thread-cell batteries in *Mœrisia* are those around the oral opening and those on the four perradial tentacles. The thread-cells of the oral battery develop in the more proximal parts of the manubrium, and make their way through the endoderm and structureless lamella to the ectoderm of the mouth-region, the movements being effected by the amœboid cnidoblasts. The nematocysts of the perradial tentacles probably develop in the large ocellar bulbs at the bases of the tentacles.

Gonadial Grooves of Aurelia aurita.*—T. Goodey discusses four narrow canals, lying in the inter-radial axes, on the ventral walls of the main passages from the central gastric cavity to the gastric pouches, and on the floors of the gastric pouches themselves. They terminate in slightly funnel-shaped expansions at about the centre of each pouch. The boundaries of each groove are formed by two parallel ridges of epithelium, which are raised up so as to form a channel between them.

From observations of numerous specimens the author has convinced himself that these gonadial grooves function as gonoducts, and that it is only within their limits that the sex-cells pass on their way to the exterior. Thus *Aurelia* may be looked upon as possessing cœlomic or archenteric derivatives of the nature of primitive gonoducts.

Indian Ocean Stylasterina.†—Sydney J. Hickson and Helen M. England report on a collection made by Stanley Gardiner, including *Distichopora profunda* sp. n., *Sporadopora providentiæ* sp. n., and *Conopora dura* sp. n. In regard to *Distichopora violacea* Pallas, it is concluded that the species is protandrous, and that the purple colour is the last of a series of colour-changes in growth.

Budding of Hydra.‡—Jovan Hadzi finds that the bud of a *Hydra* does not arise simply as an evagination of the two layers of the parent animal. Things are seldom so simple as they at first sight appear.

What, then, is a bud? It arises by local "activation" of the indifferent or interstitial cells below the ectoderm. This is shown by the fact that the beginning of bud-formation is the intense multiplication of the indifferent cells. This is the first step.

The second step is this, that the indifferent cells insinuate themselves between the ectodermic epithelial cells and become like them, and that they likewise pass through the supporting lamella and become nutritive-muscular cells. This seems to go on throughout the polyp's life. A bud may be due to the two layers as such, or to indifferent (mesenchymatous) cells.

Selaginopsis.§—James Ritchie proposes to add *Selaginopsis mirabilis* Verrill to the British list. Specimens were found in the net of a trawl-boat which had taken its last few hauls off Flamborough Head. They were quite fresh, with the perisarc in good condition, and were growing

* Proc. Zool. Soc., 1909, pp. 78–81 (1 pl.).
† Trans. Linn. Soc. London (Zool.) xii. (1909) pp. 345–54 (1 pl.).
‡ Arbeit. Zool. Inst. Univ. Wien, xviii. (1909) pp. 61–82 (2 pls.).
§ Proc. Roy. Phys. Soc. Edinburgh, xvii. (1909) pp. 217–22 (3 figs.).

on a stone. The author discusses the relation of *Selaginopsis* to *Thuiaria*. Varieties of *Thuiaria* link on to *Selaginopsis*, and colonies of *Selaginopsis* pass through a *Thuiaria* stage. It seems likely that *Thuiaria* is the older and better established genus from which the other has diverged.

Hydroids of the Scottish Antarctic Expedition.*—James Ritchie communicates a supplementary report on these. The 'Scotia' collection includes 59 distinct species, but few of these were obtained in truly Antarctic latitudes. Within latitudes higher than the extreme limit of floating ice, 9 species were obtained. The total number as yet recorded in the Antarctic circumpolar seas is 68, of which 36 must, so far, be regarded as peculiar. As regards number of individuals the area is thinly populated. The report includes a useful note on *Myriothela austro-georgiæ* Jäderholm. Two species, *Thyroscyphus tridentatus* Bale and *Plumularia lagenifera* Torrey, hitherto recorded only from the South and North Pacific respectively, have been found in the South Atlantic, and the ranges of several other species have been considerably extended. Of new forms there are described the trophosome and gonangium of *Sertularia heterodonta* from off Brazil, the trophosomes of *Antenella quadriaurita* from Gough Island, and of a variety of *Lafoëa gracillima* from deep water to the south of the South Orkneys. The gonangia of *Sertularia rathbuni* and *Antennopsis scotiæ* are described for the first time.

Hydroids from Andaman Islands.†—J. Ritchie describes a few additions to the little known deep-water hydroid fauna of Indian Seas,—*Hebella crateroides*, *Diphasia thornelyi*, *Aglaophenia septata*, *Lytocarpus annandalei*, all new species.

Porifera.

New Fresh-water Sponge.‡—N. Annandale describes *Tubella vesparioides* sp. n., from Burma. It is closely related to *T. vesparium* (Martens), from Borneo, differing from this species in its smooth, amphioxous skeleton spicule, and in the deeply indented rotule of its gemmule spicule.

Protozoa.

Optical Properties of Contractile Elements in Heliozoa.§—Doris L. MacKinnon points out that on the well-known theory of Engelmann, contraction is dependent upon the presence of doubly refracting particles (inotagmata). Engelmann claimed that all elements which contract in one definite direction are doubly refracting. Along with F. Vlès, MacKinnon has shown that the cilia of the gills of the muscle are not really doubly refractive, and that their apparent double refraction is simply due to the depolarisation of light by refraction and reflection.

* Trans. Roy. Soc. Edinburgh, xlvii. (1909) pp. 65–101 (11 figs.).
† Ann. Nat. Hist., iii. (1909) pp. 524–8.
‡ Records Indian Museum, ii. (1908) pp. 157–8.
§ Journ. Physiol., xxviii. (1909) pp. 254–8.

An examination of the axopodia of *Actinosphærium* confirms the conclusion that contraction may take place in a definite direction in the absence of doubly refractive particles.

Foraminifera from Hawaiian Islands.*—R. M. Bagg, Jr., reports on a collection of over 200 species, including the following new ones:—*Gaudryina quadrangularis*, *Bolivina semi-alata*, *Bigenerina arenacea*, *Sagraina irregularis*, and *Pulvinulina gilberti*.

Dimorphism of Ophryodendron.†—C. H. Martin finds that *Ophryodendron abietinum* is a true ectoparasite of the hydroid to which it is attached, and its contained nematocysts are derived from its host. The same is true of *O. sertulariæ*. The genus shows true dimorphism. A proboscidiform individual gives rise by a process of external budding to a vermiform individual of quite different structure. Both forms can give rise to ciliate embryos. The ciliated embryos of the proboscidiform develop on fixation into young proboscidiform individuals. It is probable that the ciliate embryos of the vermiform individuals also develop into proboscidiform individuals.

Parasites of Fishes.‡—J. Fiebiger describes a number of ectoparasitic and endoparasitic Protozoa. Among Ciliata he discusses *Chilodon cyprini* Moroff from carp, the very beautiful *Cyclochæte domerguei* from carp and eel, and *Ichthyophthirius multifiliis*, which is readily visible with the unaided eye. Among Flagellates he discusses *Costia necatrix* from sea-trout and Trypanosomes in carp. Among Sporozoa he deals with numerous forms, e.g. *Eimeria subepithelialis* from carp, *Goussia gadi* sp. n. from the swim-bladder of *Gadus virens*, *Lentospora cerebralis* Plehn in larval trout.

Amœbidium in Larvæ of Simulium.§—E. Chatton and E. Roubaud describe from the rectum of the larvæ of *Simulium argyreatum* and *S. fasciatum* a representative of the genus *Amœbidium*, which is morphologically identical with *A. recticola* found in *Daphnia magna* and *D. pulex*.

New Hæmatozoon from Sloth.‖—F. Mesnil and E. Brimont describe *Endotrypanum schaudinni* g. et sp. n. from the blood of *Choloepus didactylus*. It is an intracellular parasite, elongated like a Hæmogregarine, probably occupying a position somewhat like that of *Leishmania*, between Trypanosomes and the Hæmocytozoa.

Hæmogregarines of East Africa.¶—G. Bouet gives preliminary descriptions of a large number of Hæmogregarines which he has observed in a tortoise (*Sternotherus derbianus*), a lizard (*Varanus arenarius*), pythons and some other snakes, and a toad.

* Proc. U.S. Nat. Museum, xxxiv. (1908) pp. 113–72 (1 pl.).
† Quart. Journ. Micr. Sci., liii. (1909) pp. 629–64 (6 figs.).
‡ Verh. Zool. Bot. Ges. Wien, lix. (1909) pp. 32–48 (12 figs.).
§ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 701–3.
‖ Op. cit., lxv. (1908) pp. 581–3 (6 figs.).
¶ Op. cit., lxvi. (1909) pp. 741–3.

Origin of Hæmoflagellata in Vertebrates.*—E. Brumpt maintains that the presence of Hæmoflagellata found in Vertebrates are due to accidental intrusions of common intestinal parasites of Invertebrates—e.g., of the leech.

Species of Trypanosomes.†—A. Laveran gives an account of inoculation experiments by which he has been able to corroborate his previous conclusion that *Trypanosoma pecaudi*, *T. dimorphon*, and *T. congolense* are quite distinct species.

* C.R. Soc. Biol. Paris, lxiv. (1908) pp. 1046-8.
† Comptes Rendus, cxlviii. (1909) pp. 818–21.

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Polar Caps in Smilacina.*—H. D. Densmore has investigated the structure and function of the polar caps found in the dividing cells of the root-tips of *Smilacina amplexicaulis*. The author finds that these cells have a cytoplasm composed of a fibrous network and granules, and that preparatory to nuclear division the cytoplasm is unusually dense at the poles of the nuclei. The caps which develop from this cytoplasm are differentiated into a limiting layer and a lighter central core of meshes. Spindle fibres arise from the cap, and the latter is gradually transformed into a spindle. Multipolar caps resembling those in the pollen-mother-cells are often formed, and form an important link of connection between the diarch spindles of vegetative cells and the multipolar polyarch spindles of sporogenous cells. Two distinct types of caps and spindles are found in the exodermal layer, viz. ordinary diarch caps and spindles, and monarch caps and spindles.

Reduction Division in Agave virginica.†—J. H. Schaffner has studied the reduction division in the pollen-grains of *Agave virginica*. He finds that the resting nucleus contains chromatin granules which are massed together according to the reduced number of chromosomes; each mass probably represents a bivalent protochromosome. These masses unite and elongate until a spirem of chromatin granules is formed. The granules undergo transverse division, and the spirem shortens and arranges itself into twelve loops of varying size and shape. These loops form a wreath-like circle, which breaks up into four long, twisted chromosomes, three ring-shaped chromosomes, and five small bean-shaped chromosomes. By means of connecting fibres, the chromosomes are drawn into the equatorial plane. One or two nuclei are present, and persist after spindle-formation; they are sometimes thrown bodily out of the cytoplasm. The spindle is always bipolar, and the poles are like dome-shaped caps similar to those seen in vegetative karyokinesis. Definite asters are to be seen at the poles. The chromosomes divide transversely during metakinesis. The masses of chromatin in the resting daughter-nuclei represent twelve daughter-chromosomes. In the second division the chromosomes divide longitudinally.

Mitosis in Fucus.‡—S. Yamanouchi has studied the life-history of *Fucus vesiculosus*, with the following results. The nuclei of the vege-

* Univ. California Publications, Bot., iii. (1908) pp. 303–30 (5 pls.).
† Bot. Gaz., xlvii. (1909) pp. 198–214 (3 pls.).
‡ Tom. cit., pp. 173–97 (4 pls.).

tative cells contain 64 chromosomes, but this number is reduced to 32 in the four nuclei resulting from the first two divisions of the oogonium and antheridium. These 32 univalent chromosomes persist up to the formation of the sperm and egg, and the whole of this phase may be regarded as the gametophyte generation. The union of gametes again brings the number up to 64, and this condition, which persists until the formation of the first four nuclei in the oogonium and antheridium, is to be regarded as the sporophyte generation. Thus *Fucus* exhibits a well-marked alternation of generations.

Spermatogenesis in Dioon.*—C. J. Chamberlain has examined the staminate cone of *Dioon edule*, and finds that the sporophylls are large and bear about 250 sporangia. Each sporangium yields about 30,000 spores. The pollen-mother-cell has twelve chromosomes, but owing to early splitting the number appears larger. The single prothallial cell is persistent. The blepharoplasts arise from the nucleus with radiating streams of cytoplasm; the solid blepharoplast breaks up into granules, from which a spiral band is formed. The sperms are formed within the sperm-cells, and are larger than those of *Cycas* or *Microcycas*, but smaller than those of *Zamia*. Both nucleus and cytoplasm show a strong amœboid movement in addition to the ciliary movement. Later on the author intends to discuss the question of phylogeny.

Structure and Development.

Vegetative.

Vascular Anatomy of Microcycas.†—H. A. Dorety has studied the vascular anatomy of the seedling of *Microcycas calocoma*. The following are the chief results of her investigation. There are two hypogeal cotyledons which often fuse, and the plumule escapes by bursting the cotyledonary sheath. Root-formation is delayed. Mucilage ducts alternate with the cotyledonary strands. The siphonostelic hypocotyl has no cortical vascular tissue, but there are traces of a broken cambial zone. The strands of the cotyledons are endarch below and exarch above; those of the petiole are all exarch. The root is tetrarch, but may be triarch at the tip.

Progress of Plant Anatomy.‡—E. C. Jeffrey contributes a paper upon the progress of plant anatomy during the past decade. The author draws attention to the importance of the study of the gametophyte generation, and especially of the male gametophyte. The evidence derived from this source, however, is much extended by the study which has recently been devoted to the sporophytic generation of higher plants, where anatomical characters are as important as cytological phenomena. In proof of the value of anatomical investigations, a few examples are cited, notably that of the phylogenetic position of *Pinus*, which is now shown to be of much greater antiquity than the Yews.

* Bot. Gaz., xlvii. (1909) pp. 215–36 (4 pls. and 3 figs.).
† Tom. cit. pp. 137–47 (2 pls.). ‡ Amer. Nat., xliii. (1909) pp. 230–7.

Reference is also made to the "recapitulationary confirmation of the principle of evolution," which has been brought to light by anatomical investigations, and it is shown how such recapitulationary evidence confirms the opinion as to the primitiveness of the "breech-fertilised" Amentiferæ. Finally, the author briefly mentions how the views set forth by anatomists as to the position of the Cycadofilices have been fully confirmed, and urges the importance of continued investigation of internal morphology.

Recent Advances in Vascular Anatomy.*—J. M. Coulter contributes a paper upon the recent advances made in the study of vascular anatomy, especially that of the reproductive structures. The present work is a brief résumé of the modern views of vascular anatomy, as based upon an evolutionary basis. It is shown that the old idea as to certain great groups of plants having been derived from other existing groups, is no longer tenable. The discovery of the Pteridosperms has shown the improbability of the descent of the Gymnosperms from the Ferns, although modern ferns may illustrate stages in the evolution of Gymnosperms. Recent discoveries on the history of the Gymnosperms show that they originated from fern-like plants bearing microsporangia and megasporangia, and that a strobilus was gradually evolved. The Cycads retain more primitive characters in their sexual reproduction and vascular system, while the Cordaitales have developed a more advanced vascular system which is continued in Ginkgoales in one direction and Coniferales in the other. It is especially to be noted that primitive features cannot be regarded as a mark of age unless history confirms their testimony. Finally, after a brief allusion to the modern conception of the monocotyledons as "a specialised offshoot from the primitive dicotyledonous stock," the writer draws attention to the need of the combination of several investigators upon one problem, where the latter entails great labour, and is important enough to justify such a united effort.

Reproductive.

Pollen of Microcachrys tetragona.†—R. B. Thomson has examined the pollen-grains of *Microcachrys tetragona*, and finds that they are small and have two to six wings, which arise in the usual way. The wings arise late, thus giving evidence of recent acquirement. Four prothallial cells are often present, but three is the more usual number. The structure of the gametophyte agrees with that ascribed by recent investigators to allied forms. The character of the wings places *Microcachrys* intermediate between *Saxegothæa* on the one hand and *Dacrydium* and *Podocarpus* on the other. The author finds no reason for regarding the wing-formation as indicative of affinity between the pines and podocarps, and hopes later on to show essential differences in the character of the megasporophylls of these two great phyla of Conifers.

* Amer. Nat., xliii. (1909) pp. 219–30.
† Bot. Gaz., xlvii. (1909) pp. 26–9 (2 pls.).

General.

Incomplete Dichogamy in Zea Mays.*—J. Burtt-Davy contributes a short note upon the pollination of the Maize. The writer made observations upon plants of *indentata* × *indurata* and found that 75·75 p.c. of the plants were protandrous, while only 24·24 p.c. were protogynous. The numbers appear to be in Mendelian proportions, and it is possible that protandry is dominant in one parent and protogyny in the other. This result is contrary to that usually obtained, and it is also to be noted that where dichogamy occurs in Maize, it is a distinct aid in preventing self-pollination. The author believes it possible that our present types of Maize are really the product of hybridisation.

Insects and the Asclepiadaceæ.†—J. K. d'Herculais contributes a note upon the connection between *Araujia* and other Asclepiads with such insects as the Hymenoptera, Lepidoptera, and Diptera. The writer has had many opportunities of observing the visits of insects to these flowers, and does not agree with the usual opinion as to the use of insects in bringing about pollination. Between each pair of stamens is a well-formed groove, expanded at the base but narrowing towards the upper end, and connected with this groove is a spout-like, elastic retinaculum. When an insect inserts its proboscis into the nectary, it is thus unable to withdraw it, but hangs helplessly until it dies of exhaustion. When the flower is mature the insect can visit it with impunity and remove the pollinia, but it is remarkable that the visits are then less frequent. The rôle of insects in effecting pollination is probably much less important than is usually supposed.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

Alternation of Generations.‡ — V. H. Blackman publishes a criticism of W. H. Lang's recently promulgated theory as to alternation of generations and ontogeny, and discusses particularly the question of the physiological reason for the difference of gametophyte and sporophyte. He does not accept Lang's view that the egg and the spore develop so differently as a result of external conditions ; that the egg, being protected and nourished in the archegonium, becomes the large differentiated sporophyte, while the spore, cast loose on damp earth, produces the small prothallus. He believes rather that the various stages are united together by a cyclical correlation, one stage influencing the development of the other (but he does not attempt to explain the mode of origin of the two generations). He cites in illustration the life-cycle of *Puccinia graminis*, the metamorphosis

* Journ. of Bot., xlvii. (1909) pp. 180–2.
† Comptes Rendus, cxlviii. (1909) pp. 1208–10.
‡ New Phytologist, viii. (1909) pp. 207–18.

of many insects, the microspores and megaspores of *Selaginella*, the two generations in *Dictyota*, the life-cycles in Foraminifera and the malaria Protozoa. External conditions may have their value as orientating stimuli.

Force Exerted by Growing Plants.*—G. E. Stone writes about the power of growth exhibited by ostrich ferns (*Onoclea Struthiopteris*) around his house. Young shoots frequently force their way up through an exceptionally hard tar-concrete pavement 2½–3 in. thick. By experiments made with a weighted lever he estimates that the young shoots exert a force of about 190 lb. upon the concrete. He cites other instances of the force exerted by growing plants.

Sporophyll of Lycopodium inundatum.†—M. G. Sykes publishes a note on the sporophyll of *Lycopodium inundatum* in defence of her position, adopted in her recent paper on the morphology of the sporangium-bearing organs of the genus *Lycopodium*, against the criticism of W. H. Lang. The disputants had used the same definition in somewhat different senses.

Mesozoic Equisetales.‡—T. G. Halle publishes an account of the Mesozoic Equisetales of Sweden, in the Upper Triassic and Lower Jurassic. He describes the stems and cones of several species, and makes the new genus *Neocalamites*, possessed of characters partly like those of Calamites, partly of *Equisetum*. The spores of Equisetites lack the elaters of *Equisetum*, and have the triradiate sculpture described for the megaspores and microspores of Calamites.

Lastrea remota in Ireland.§—R. Lloyd Praeger gives an account of a fern which he found at Dalystown in south-east Galway in 1898, and has kept under cultivation ever since. His conviction that it is *Lastrea remota* has recently been confirmed by Dr. F. W. Stansfield. *L. remota* was first discovered in Germany in 1843, and has been rather a puzzle to botanists, having been referred to *L. Filix-mas*, *L. spinulosa*, and *L. dilatata*. It is now regarded as a hybrid of the first two of those species, a view which is in keeping with its curiously restricted range. Praeger shows that it is found in the vicinity of the two parent species, and points out how it resembles and differs from those species. He cites some interesting passages from literature about it.

Spanish Ferns.‖—P. B. Merino publishes some notes on the ferns of Galicia. He gives a list of 31 species grouped in 18 genera, including 8 additions to the flora of Galicia, which contains 70 p.c. of the species recorded for the whole of Spain.

F. de las Barras ¶ publishes some notes on the cultivation of fern-spores, methods for which he has recently been studying in England.

* Bull. Torrey Bot. Club, xxxvi. (1909) pp. 220–5 (figs.).

† New Phytologist, viii. (1909) pp. 143–5 (figs.).

‡ K. Svensk. Vet. Akad. Handl., xliii. No. 1 (1908). See also Bot. Gaz., xlvii. (1909) p. 424.

§ Irish Naturalist, xviii. (1909) pp. 151–3.

‖ Bol. R. Soc. Española Hist. Nat., ix. (1909) pp. 188–91.

¶ Tom. cit., pp. 199–206 (figs.).

Among the species cultivated were *Polypodium Phymatodes*, *P. nigrescens*, and *Pteris droogmansia*. The methods and precautions adopted are described.

Madeira Ferns.* — C. A. Menezes has produced a catalogue of Madeira ferns, translated by H. Gilbert. He gives descriptions of forty-five species and some varieties, and provides a key to the genera.

North American Ferns.—R. C. Benedict † gives a brief account of the fern collections of the New York Botanical Garden, as found in the herbarium, the palæobotanical section, the gardens, the houses, and the economic section. He also writes ‡ about the type and identity of *Dryopteris Clintoniana*, D. C. Eaton's description of which seems to have been based not on Clinton's specimen cited as type, but upon other specimens in Eaton's herbarium. Clinton's specimen is probably a cross with *D. Goldiana*. E. J. Winslow § publishes some notes on *Nephrodium* hybrids collected in Orleans County, Vermont, where they abound in a primeval swamp. Ten hybrid forms were found and identified. The author discusses the various hybrids, their frequency of occurrence, etc. C. T. Simpson ‖ gives an account of difficulties met with whilst collecting in the Everglades of Southern Florida. New ferns and other plants were discovered. A. Prescott ¶ publishes a simple account of *Nephrodium noveboracense*. E. L. Lee ** writes of the the ecology of *Asplenium Bradleyi*, as found near Bridgeport in North Alabama. The plants grow out of seams of dry sandstone rocks at an altitude of 1600 ft. W. N. Clute †† gives an account and a figure of *Lycopodium alopecuroides* var. *adpressum* f. *polyclavatum*, an abnormal fasciated form known only from southern Staten Island until recently, when it was found at Sanford, Florida. He also gives an account ‡‡ of *Asplenium pumilum*, a dwarf spleenwort, found in Jamaica and other parts of the tropics. He also reproduces, §§ with some comments, J. H. Schaffner's recently published arrangements of the groups of the Pteridophyta. J. Shepard ‖‖ describes a method of preparing blue print paper for making fern prints. W. N. Clute ¶¶ publishes an article on "Travelling Ferns." C. F. S. *** writes about *Scolopendrium vulgare*, one of the rarest of American ferns.

South American Ferns.†††—G. Hieronymus publishes the fourth part of his enumeration of the Pteridophytes collected by A. Stübel during his journeyings in Colombia, Ecuador, Peru, and Bolivia. He enumerates 275 ferns and 27 fern-allies, including descriptions of 18 new species and 19 new varieties.

* Funchal: Diario Popular (1906) 22 pp.
† Journ. New York Bot. Gard., x. (1909) pp. 75–81 (figs.)
‡ Torreya, ix. (1909) pp. 133–40 (2 figs.).
§ Fern Bulletin, xvii. (1909) pp. 33–88.
‖ Tom. cit., pp. 38–41.
¶ Tom. cit., pp. 42–3.
** Tom. cit., pp. 43–5.
†† Tom. cit., pp. 45–8 (fig.).
‡‡ Tom. cit., pp. 48–50 (pl.).
§§ Tom. cit., pp. 50–4.
‖‖ Tom. cit., pp. 54–5.
¶¶ Tom. cit., pp. 55–7.
*** Tom. cit., pp. 57–8.
††† Hedwigia, xlviii. (1909) pp. 215–303 (6 pls.).

Pteridophytes of Samoa.*—K. Rechinger gives an account of the Pteridophytes collected in Samoa by him in 1905, comprising 153 species and many varieties. He discusses the ecology and biology of the plants. He expresses his preference for the grouping adopted in Hooker and Baker's Synopsis. One new species of *Pteris* is described.

New Spleenwort from China.†—W. R. Maxon gives a description and figure of *Asplenium microtum*, collected in Yunnan by A. Henry, and hitherto referred to *A. Trichomanes*, from which it differs in its tougher texture, auriculate pinnæ, revolute margins, chaffy bud on rachis. The chaffy bud is a character occurring commonly in the allied species *A. monanthes*.

Chinese Ferns.‡ — H. Christ publishes an account of some new Chinese ferns collected by F. Ducloux, A. Henry, Giraldi, Delavay, Faber, Esquirol, C. G. Matthew, E. Wilson, G. Silvestri, and others. Fifty species are enumerated, and twenty-seven of them are described for the first time; eleven new varieties are also described. The majority of the specimens described were collected at Yunnan-sen by F. Ducloux.

He also describes § two new species of ferns collected in Cambodia by Bouillod.

Ferns of the Malay-Asiatic Region.‖—E. B. Copeland begins the publication of a fern-flora of the Malay-Asiatic region, with keys and descriptions of the families, genera, and species. In the present part he treats of the Ophioglossaceæ, Marattiaceæ, Marsileaceæ, Salviniaceæ, Osmundaceæ, Schizæaceæ, Gleicheniaceæ, Parkeriaceæ, Matoniaceæ, Cyatheaceæ, and gives a series of plates in illustration of the genera.

New Exotic Ferns.¶—E. Rosenstock publishes descriptions of five new ferns—*Asplenium tenuiculum*, *Dryopteris Rimbachii*, *Polypodium trichiatum*, *Elaphoglossum palorense*, *Cyclophorus Winkleri*—the first from New Caledonia, the last from western Sumatra, the others from Ecuador.

C. M. Hicken** gives an enumeration of sixteen ferns, all new to Argentina; three of them and five varieties are new to science. Critical notes are added.

Bryophyta.

(By A. Gepp.)

Two New British Hepaticæ.††—S. M. Macvicar gives an account of *Sphærocarpus californicus*, pointing out the characters by which it is

* Denkschr. Math. Nat. k. Akad. Wiss. Wien, lxxxiv. (1908) pp. 401–49 (4 pls. and 12 figs.).
† Contrib. U.S. Nat. Herb. Washington, xii. (1909) p. 411 (pl.).
‡ Notulæ Systematicæ Herb. Mus. Paris, i. (1909) pp. 33–58.
§ Tom. cit., pp. 58–9.
‖ Philippine Journ. Sci., iv. (1909) pp. 1–64 (21 pls.).
¶ Fedde's Repertorium, vii. (1909) pp. 146–50.
** An. Soc. Cient. Argent., lxii. (1906) pp. 161–88 (8 pls.). See also Fedde's Repertorium, vii. (1909) pp. 169–73.
†† Journ. of Bot., xlvii. (1909) pp. 306–9.

distinguished from *S. Michelii.* It has been growing in a garden at Woking for some years, but has only recently been definitely determined. The plant was first recorded for Europe by Douin in 1907, as occurring in the French department of Eure-et-Loire. At Woking the plant grows in a garden supplied with shrubs from big nursery gardens in the vicinity: but all inquiries fail to elicit any evidence that it was introduced into this country with plants from California. The European plants referred to *S. Michelii* require re-examination. He also gives a description of *Aplozia cæspiticia* Dum., gathered in the Isle of Wight last November by H. H. Knight, and shows how it is distinguished from other species, notably by its terminal ball of gemmæ. It is a rare plant, though widespread on the Continent.

Tortula cernua Lindb.* — W. Ingham records a second British locality for *Tortula cernua*, which was first discovered in Britain nine years ago. Both localities, Aberford and Doncaster, are in Yorkshire.

Hepaticæ of South Lancashire.†—J. A. Wheldon and W. G. Travis give an enumeration of eighty-three hepaticæ found in south Lancashire, with localities, collectors, deceased and living, notes, bibliography, and an introductory sketch. Corticolous species are rare owing to the smoky atmosphere. The best stations are the remains of the old moss-land. The sand hills between Liverpool and Southport yield some interesting species.

Shropshire Hepaticæ.‡ — W. G. Travis records a few hepaticæ which he found on Longmynd, near Church Stretton, and which are additions to the list given by W. P. Hamilton in the Victoria History of Shropshire, 1908.

Worcestershire Muscineæ.§—J. E. Bagnall and others contribute a list of 293 mosses and 76 hepatics to Amphlett and Rea's Botany of Worcestershire. An interesting item is *Octodiceras Julianum* at Bewdley, in the Severn.

Irish Muscineæ.‖ — C. H. Waddell records the occurrence of the hepatic *Ptilidium ciliare* on the top of Colin Mountain in Co. Antrim. It is rare in Ireland, possibly escaping notice by its habit of growth, usually in single stems, mixed with *Dicranum* and other mosses.

H. W. Lett ¶ records the finding of *Catharinea rhystophylla* at Saintfield, Co. Down, in May, 1908. That species is a native of north China and is allied to *C. angustata.* It was growing on the mud-capped top of an old stone wall, in association with *Ceratodon purpureus* and *Stereodon cupressiforme.*

D. McArdle** gives lists of forty-seven mosses and eighteen hepatics from Co. Fermanagh, and twenty-three mosses and fifteen hepatics

* Naturalist, No. 630 (1909) p. 270.
† Trans. Liverpool Bot. Soc., i. (1909) pp. 32–46.
‡ Journ. of Bot., xlvii. (1909) p. 324.
§ Birmingham: Cornish Brothers, 1909, pp. 444–87.
‖ Irish Naturalist, xviii. (1909) p. 119.
¶ Tom. cit., p. 120. ** Tom. cit., pp. 144–9.

gathered by him on Slieve League. The more interesting species were *Orthothecium intricatum* and *Scapania subalpina*.

C. H. Waddell * states that *Splachnum vasculosum* is not an Irish species, but has been inserted in the flora by mistake for *S. sphæricum*.

Norwegian Mosses.†—I. Hagen publishes a second instalment of his preliminary studies for a Norwegian moss-flora, and treats of the following seven families: Meeseaceæ, Georgiaceæ, Disceliaceæ, Neckeraceæ, Pseudoleskeaceæ, Thuidiaceæ, Leskeaceæ. A novel feature in the present instalment is that the critical notes, and all matter not exclusively of Norwegian interest, are printed in French.

Hepaticæ of Belgium.‡—A. Mansion's flora of the hepaticæ of Belgium is advanced a second stage. Left incomplete at the death of the author, this instalment has been filled in and set in order by C. Sladden and E. Marchal. It treats of the genera *Marsupella* (4 species), *Mesophylla* (6), *Coleochila* (1), *Aplozia* (9), *Liochlæna* (1), *Lophozia* (18); and contains descriptions, distribution, critical notes, and keys.

Muscineæ of the Swiss Oberland.§—P. Culmann publishes a further contribution to the moss-flora of the Bernese Oberland, including eleven hepatics and thirty-seven mosses, with critical notes. He describes and figures the fructification of *Molendoa tenuinervis* Limpr., found for the first time.

Italian Mosses.‖—A. Bottini gives an enumeration of new or noteworthy Italian mosses collected or determined in 1908, and arranged according to the provinces of Italy, together with canton Ticino and the island of Corsica. Several species and numerous varieties are new to the district treated. G. Zodda¶ publishes some lists of Bryophytes of southern Italy—121 mosses and seventeen hepatics from the Neapolitan provinces from Naples to Potenza, and sixty-five mosses and nine hepatics from the three Calabrian provinces of Cosenza, Catanzaro and Reggio. He describes a new hybrid *Bryum atropurpureum* × *B. murale*, and records the occurrence of *Riccia insularis* on terra firma near Baia. G. Zodda** also publishes his third annual contribution to the moss-flora of the province of Messina, enumerating thirty-three hepaticæ and 200 mosses, with habitats, notes, and remarks. Seven forms new to science are described; and several species and forms are added to the Sicilian, and some to the Italian flora.

Austrian Mosses.††—J. Glowacki gives an account of the genus *Eucladium*, of which there are now four species in Europe—*E. verticillatum* Bry. Eur., *E. commutatum* Glow. (1906), *E. styriacum*, a new

* Irish Naturalist, xlviii. (1909) p. 156.
† K. Norsk. Vid. Selsk. Skrifter, 1908, No. 9, 122 pp.
‡ Bull. Soc. Roy. Bot. Belg., xlv. (1908) pp. 29–83.
§ Rev. Bryolog., xxxvi. (1909) pp. 91–7 (figs.).
‖ Bull. Soc. Bot. Ital., 1909, pp. 103–18.
¶ Malpighia, xxiii. (1909) pp. 23–54.
** Ann. di Bot., vii. (1909) pp. 449–87.
†† Oesterr. Bot. Zeitschr., lix. (1909) pp. 222–4.

species here described by the author, and *E. angustifolium* (Jur.) Glow. The last three occur in the Adriatic region. The author provides a key to the species. H. Sabransky * records *Catharinea Haussknechtii* from Styria, richly fruiting, and describes in detail how it differs from *C. undulata*, with which, and with *C. angustata*, it was found growing.

European Hepaticæ.†—K. Müller publishes the eighth part of his *Die Lebermoose* in Rabenhorst's Kryptogamen-flora. He continues his account of the Epigoniantheæ, finishing the genus *Marsupella* (15 species), and describing *Prasanthus* (1), *Southbya* (2), *Arnellia* (1), *Gongylanthus* (1), and *Alicularia* (unfinished).

North American Bryophytes.‡ — E. G. Britton publishes her eleventh chapter of notes on nomenclature, taking for her subject the concluding parts of Brotherus' classification of the mosses in Engler and Prantl's Pflanzenfamilien, and discussing the position allotted to several American species. She changes the new generic name *Williamsia* into *Williamsiella*, the former name having been coined a few months previously for a phanerogamous plant. A. S. Foster § gives a list of twenty-five bryophytes and thirteen lichens from Mount Hood, Oregon. C. C. Haynes ‖ gives an enumeration of the Washington and Oregon hepaticæ collected by A. S. Foster in 1904–9, sixty-three species with localities and a few notes. L. Clark¶ gives an account of some noteworthy hepaticæ from the State of Washington, nine in number, including a new species, a new variety, four species new to North America, and three new to the United States. Critical notes are appended. The author remarks that the State, though favourable for a rich hepatic vegetation, has been much neglected, but that he has identified 101 hepatics from the State in various collections. N. C. Kindberg ** describes three new mosses from British Columbia, collected by A. Brinkman, and six from Colorado, collected by N. L. T. Nelson.

Mexican Mosses.††—J. Cardot publishes a second chapter of preliminary diagnoses of Mexican mosses, describing twenty-one species belonging to the genera *Didymodon*, *Barbula*, *Splachnobryum*, *Tortula*.

Mosses of Annam.‡‡—E. G. Paris publishes his eleventh article on the Muscineæ of eastern Asia, giving notes on eleven species collected by Eberhardt at Hué, in Annam, and including descriptions of three new species.

Critical European Mosses.§§—E. Bauer publishes critical remarks on European mosses, issued in the seventh series of his Musci Europæi Exsiccati, treating of *Pohlia carinata* at considerable length, and discussing the views taken by Winter, Limpricht, and Loeske.

* Oesterr. Bot. Zeitschr., lix. (1909) p. 272–3.
† Leipzig: Kummer, 1909, lief 7, pp. 449–519 (figs. 244–66).
‡ Bryologist, xii. (1909) pp. 62–3.
§ Tom. cit., p. 64. ‖ Tom. cit., p. 65–71.
¶ Bull. Torrey Bot. Club, xxxvi. (1909) pp. 299–307 (1 pl.).
** Rev. Bryolog., xxxvi. (1909) pp. 97–9.
†† Tom. cit., pp. 81–8. ‡‡ Tom. cit., pp. 88–91.
§§ Hedwigia, xlviiii. (1909) pp. 319–28.

L. Loeske * publishes further critical remarks concerning certain mosses collected by him in the Algäuer Alps. 1. *Brachythecium reflexum*, its var. *subglaciale*, *B. glaciale* var. *dovrense*, and *B. tromsöense* form a continuous chain. The last named is a snow-water form of *B. reflexum*. 2. *B. glaciale* probably is the last evolved link of the chain *B. curtum-B. Starkei*. 3. *Pohlia commutata*, *P. cucullata*, *P. Rothii*, and *P. gracilis*, in the high Alps on firm ground, all form low patches with appressed leaves and distinct five-angled stem. They may be designated as var. *carinata* of their respective species. 4. Limpricht's *Webera carinata* is probably a carinate form of *Pohlia commutata*. 5. The *P. carinata* of Bauer's Exsiccati, No. 312, does not agree with Limpricht's description, and is possibly merely a hygrophilous form of *P. cucullata*. 6. *Webera Payotii* is not a proper species, but consists of hygro-hydrophilous extremes of *Pohlia gracilis*, *P. torrentium*, and *Anomobryum filiforme*. 7. *Bryum filum* Schimp., is *P. gracilis* var. *elata*. 8. Owing to the great difficulty in distinguishing sterile forms of *Pohlia* from the high Alps, and to the variability of these forms, according to their place of growth, it is indispensable for the collector to take careful note of the conditions of the habitat and of the associations of the plants.

Forms of Drepanocladus.† — W. Mönkemeyer publishes critical remarks on G. Roth's recent synopsis of the European forms of *Drepanocladus*, and complains of the practice of Roth and others of creating small and artificial species, and gives numerous instances, pointing out that many of them are seasonal forms.

L. Loeske, ‡ writing of *Drepanocladus furcatus* Roth and v. Bock, expresses his firm conviction, shared also by Mönkemeyer, that it is nothing but *Hygrohypnum ochraceum* var. *uncinatum*, and that it is in no way connected with *Drepanocladus*, and does not in any way form a connecting link with that genus.

Sphagnum robustum.§—J. Röll discusses the history of the species *Sphagnum robustum* Röll, and of the treatment which it and he himself have received at the hands of C. Warnstorf; and he criticises severely the views and methods of that author, especially in respect of the pores in the leaf-cells of *S. robustum*.

Climacium dendroides var. turgescens.‖ — P. Janzen describes and figures a new variety of *Climacium dendroides*, collected near Pontresina. The leaves of this var. *turgescens* are broadly ovate, boat-shaped, cucullate, and auricled, obscurely denticulate above. A. Geheeb is of opinion that the plant is possibly a new species.

Hypogastranthus, a New Genus.¶— V. Schiffner describes and figures *Hypogastranthus*, a new genus of hepatics. The plants were collected by him in Sumatra sixteen years ago, and sterile specimens were issued in his Exsiccatæ as *Lophozia* (?) *sumatrana*. Subsequent discovery of its male and female inflorescences enables him to describe

* Hedwigia, xlviii. (1909) pp. 329–39.
† Tom. cit., pp. 309–15.
‡ Tom. cit., pp. 316–18.
§ Allgem. Bot. Zeitschr., xv. (1909) pp. 102–5.
‖ Hedwigia, xlviii. (1909) pp. 340–4.
¶ Tom. cit., pp. 304–8 (pl.).

it as a new genus, resembling *Acrobolbus Wilsoni* in its leafy shoots and leaf-shape, but distinguished by the ventral abbreviated male and female branchlets.

W. Wollny * describes and figures *Sphenolobus filiformis*, a new species of hepatics from the Kitzbuhel Alps of Tyrol. It is very like *Cephalozia* in habit.

Fruiting State of Campylopus polytrichoides.† — G. Dismier announces the discovery of *Campylopus polytrichoides* in a fruiting state in France. In 1881 it was recorded for Portugal, in 1906 for Spain, and a fruiting Portuguese specimen has since been found in the Paris Museum. Last December Dismier found it in France, growing abundantly in the western Pyrenees at Saint Étienne de Baïgorry. He gives a description of the sporogonium, and sketches out the area of distribution of the species, a silicicolous plant, limited to the western and southern regions of Europe, north Africa, the Atlantic Islands, Madagascar, the United States, and Brazil.

Teratology in Pogonatum.‡ — E. Ballé describes an instance of teratology presented by a plant of *Pogonatum aloides*, found at Vire (Calvados). It bore a divided leaf with normal nerves and denticulations. Descriptions and measurements are given.

Cohesion-mechanism of Moss-leaves.§— C. Steinbrinck continues the discussion on the cohesion-mechanism of the leaves of *Polytrichum*, and replies to the arguments of W. Lorch, and is in entire disagreement with him, denying that there is any cohesion-mechanism of the kind described by Lorch. He thinks the latter attaches a wrong meaning to the word cohesion.

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

British Fresh-water Phytoplankton.‖—W. and G. S. West embody the results of their joint study of British fresh-water plankton in an important paper, adding thereto their views on Desmid plankton in general, and the distribution of British Desmids. After some introductory remarks, they describe shortly the constituents of the Scottish lakes, the lakes of the Orkneys and Shetlands, the Irish lakes, Lough Neagh, the Welsh lake area, the English lake area, Malham Tarn, in West Yorkshire, and the British river plankton ; and then give a tabulated list of all the species observed in the phytoplankton of the British Islands, which include 506 species and 118 varieties. Of this total 46 p.c. were species of the Desmidiaceæ.

In a general summary the authors state that the British lakes com-

* Hedwigia, xlviii. (1909) pp. 345–6 (pl.).
† Bull. Soc. Bot. France, lvi. (1909) pp. 273–6.
‡ Rev. Bryolog., xxxvi. (1909) p. 100.
§ Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 169–76 (figs.).
‖ Proc. Roy. Soc., Series B, lxxxi. (1909) pp. 165–206 (figs.).

bine to some extent the characteristic features of the Central European and Northern European lakes, but are, on the whole, more nearly akin to the latter. In addition, they have peculiarities which mark them off from either of these groups ; for instance, the relatively high temperatures in winter. The phytoplankton is never of very great bulk, and it is quite exceptional for it to colour the water to any appreciable extent.

The Myxophyceæ play quite a secondary part in the plankton of the British lakes as compared with the Central European lakes. The Flagellata are well represented by various Peridinieæ. The Bacillarieæ are abundant, but they rarely occur in such great quantities as in the Central European lakes. The Chlorophyceæ are well represented, more especially by the Desmidiaceæ : indeed, the most interesting feature of the British fresh-water phytoplankton is the dominance of Desmids. In this point the plankton of the western British lake areas differs markedly from all other European plankton. The authors discuss at some length this phenomenon of the rich Desmid flora, and begin by giving a brief outline of the general distribution of the Desmidiaceæ in the British Islands, quite irrespective of the fresh-water plankton. They note the much greater richness in the western areas of the country as compared with the eastern, which are exceedingly poor. On passing from the newer Tertiary formations to the older Palæozoic and Precambrian formations, the Desmid flora gradually increases in richness, attaining its maximum diversity in certain of the Precambrian areas. Thus it is obvious, that since the great majority of the British lakes are situated in the western parts of our islands, and the western districts are the richest in Desmids, the plankton of these lakes should naturally contain an abundance of Desmids. So much is this the case, that the plankton may be correctly described as a Desmid-plankton.

As regards the relationship between the conditions of environment and the richness of the Desmid flora, the authors find that :—1. The rich Desmid areas correspond very accurately with the areas of the old geological formations ; they are mostly mountainous districts, with considerable outcrops of igneous rocks. 2. These areas also correspond, but with less accuracy, to the areas of greatest rainfall. The comparative absence of Desmids from certain localities in the Pennine Chain and in the New Forest, which would seem ideal habitats for those plants, is explained by the fact that the richness of a Desmid flora bears a distinct relationship to the antiquity of the geological formations of the area under consideration ; and the richest floras are only found in those areas which combine the most suitable habitats (boggy hillsides with an abundant rainfall), with a drainage-water derived from geological formations older than the Carboniferous.

The authors consider that the Desmids of the plankton have without doubt originated from the Desmid community of the surrounding area. They find, also, that neither plankton Desmids, nor those which occur in other situations, undergo any seasonal form-variations. Finally, they comment upon the cosmopolitanism of the fresh-water plankton community, except as regards Desmids. For that group they find that wherever there are lakes with a rich Desmid flora in the plankton, there one also gets a more or less definitely localised plankton community.

They give instances of three distinct plankton communities :—(1) the Desmids of the British plankton ; (2) those of Victoria Nyanza ; (3) those of Victoria, as exemplified by the Yan-Yean reservoir.

Phytoplankton of the English Lakes.*—W. and G. S. West continue their report on the phytoplankton of the English lake district. They complete the tables begun in the last part, and then give details as to the periodicity of the plankton of Windermere, month by month. The dominant constituents are Chlorophyceæ and Diatoms, the Myxophyceæ never at any time being conspicuous. In all sixty-five species have been observed. The plankton of Windermere has three fairly distinct phases :—1. January to April (cold period). *Melosira granulata* phase. During February and March the phytoplankton is at its minimum. 2. May to July (vernal rise of temperature). First maximum of *Asterionella gracillima* in May and June. 3. August to December (autumnal fall of temperature). The Desmid phase extends from August to November, and is most noticeable in September and October. In November is a second maximum of *Asterionella gracillima*. The Chlorophyceæ attain their maximum abundance in September and October. The diatoms do not attain a universal maximum at one definite period of the year, but the various plankton-species reach their maxima at different periods.

The authors suggest that the great maxima of *Asterionella*, which occur in the British Isles, may be due to the favourable spring and autumn temperatures, and the fact that at those seasons the food supply would be greatest. Few of the Myxophyceæ occur in Windermere, and of these *Cœlosphærium Kützingianum* is the most conspicuous. Only two species of Peridinieæ are recorded, *Ceratium hirundinella* and *Peridinium Willei*. Seven figures of the latter are given. Three Flagellata are recorded.

The authors† then proceed to give a systematic account of the more noteworthy species among the phytoplankton of the English lakes. Of the twenty-eight species so treated, one is here described for the first time (*Dinobryon crenulatum*), one is new to Britain (*Elakatothrix gelatinosa*), and thirteen are new to England.

A table is appended in which the comparative frequency or absence of each species during each month in the year is shown.

Peridinieæ of Sutton Park, Warwickshire.‡—G. S. West has been making more or less continuous observations of the general periodicity and life-histories of the algæ which occur in Sutton Park, Birmingham. Seven species of Peridinieæ have been observed in the pools and bogs. Only one of these, *Glenodinium uliginosum*, is a bog species, the other six having been found in the helioplankton of a sheet of water of about 16 acres. Notes are given on each of the seven species recorded, one of which, *Peridinium anglicum*, is new. The periodicity of the various species is shown on a chart.

* Naturalist, No. 628 (1909) pp. 186–193 (1 fig. and 1 chart).
† Tom. cit., pp. 260–7 (1 fig.).
‡ New Phytologist, viii. (1909) pp. 181–96.

Water-bloom.*—E. Wolf discusses the question of the "bloom" on water as an important factor in the life-cycle of organic life. He divides the organisms, which compose the bloom, into four classes, one of which is Algæ, i.e. Schizophyceæ, Diatomaceæ, and Chlorophyceæ, particularly Desmidiaceæ. The colour of the bloom may be green, yellow, red, or black, and the principal constituents of the bloom of each colour is given. The thick slime of seas or lakes is also described: that of the Adriatic being caused by Peridinieæ. As regards the role played by this water-bloom in the general economy of nature, the author points out:—1. The organisms which form it possess the power of building up living material from inorganic substance. 2. Their importance is universal, since they are found in fresh and in sea water. 3. The thick covering is of the greatest importance to their allies the bacteria, which work in the mud, since sunlight hinders their activity, even killing them; and it is the bacteria which render the insoluble nitrogenous matter soluble and useful to plants, as well as decomposing refuse. 4. The bloom also acts as a purifier of water, destroying and using up decaying matter. 5. Many of them are also guides to the connoisseur, their presence showing at once whether the water is pure or foul. 6. By their extraordinary power of reproduction they prevent any excess of dissolved material. In the sea they are also assisted by the denitrification bacteria. 7. In consequence of their large mass, they form the most abundant source of nourishment to the animal life of the water: they are indispensable in fish culture. 8. They enrich the water to a high degree with oxygen, which benefits the fish. These considerations show clearly what a powerful factor the water-bloom is in nature.

Marine Plankton.†—H. Lohmann has written three interesting treatises on the subject of marine plankton in general, and throws light on many vexed questions. He finds that many of the conclusions with regard to the plankton-mass in any special region are often inaccurate, since the mesh of the miller's gauze used (No. 20) is not fine enough to insure the capture of the smallest organisms, and many of them slip through and are lost. These are, of course, of the greatest importance from the point of view of food-supply, and no summary is complete which omits to take them into account. The author describes a much more exhaustive method of catching plankton, by which nothing except bacteria can escape; and the result of his investigations in Kiel Bay records many notable additions to the already known plankton-flora. He criticises also the method employed for measuring the volume, and describes his own improvements. He finds that from February to the second half of August the plankton-mass steadily increases, and then declines. The winter poverty is distinguished by a preponderance of animals, and the summer richness by a preponderance of plants. The supposed spring and autumn maxima, with the intermediate temporary decline of summer, is shown to be due entirely to the failure of the nets

* Ber. Senckenberg. Naturf. Gesell. Frankfurt a. M., 1908, pp. 575–7.

† Wissenschaftl. Meersuntersuch. Abt. Kiel, x. (1908) pp. 122–370. Internat. Revue d. gesamten Hydrobiologie u. Hydrographie, i. (1908) pp. 309–23. Naturwissenschaftl. Wochenschrift, vii. n.s. (1908) pp. 801–10.

to catch the small protista which occur in masses during the summer, and take the place of the diatoms which abound in spring.

Another generally accepted theory is here contested. It has yet to be proved that the tropical seas are poorer than the polar regions in plankton, for it is possible that in the warmer seas there may be a large number of the smallest organisms which have escaped the net. Indeed, the author shows that the Coccolithophorideæ abound in masses in the upper layers of the warm oceans, and he thinks it probable that the rate of reproduction is much greater in the tropics.

The author then gives some interesting and important facts regarding the Coccolithophorideæ and the formation of sediment in the sea. These organisms, together with the Peridinieæ and Diatoms, form the most important elements of nutrition and sediment.

In the third of the treatises mentioned the views of Brandt, Nathanson, and Putter are very clearly stated, and criticisms are made by the author on certain points.

The three papers in question are important contributions to the literature of plankton study, and a good résumé of them is given in Hedwigia.*

Phytoplankton of the West Indies.† — B. Schröder gives an account of the phytoplankton collected at St. Thomas and the Tortuga Islands. The phytoplankton was relatively small—70 forms from St. Thomas, mostly tropical surface forms. From Tortuga came a much greater preponderance of microscopic zooplankton. Notes on three species are given ; one of the species is new.

Phytoplankton of the North Atlantic.‡ — W. Stüwe publishes a very full report of various collections of plankton, which were made at the instigation of Professor Schütt, by captains of vessels crossing the Atlantic. In particular, the collection of Captain Reinecke, made in the Gulf-stream, the Canary, the North and South Equatorial, and the Guinea currents, and in the Sargasso Sea, appears to have been very valuable. The plankton is treated from a qualitative and a quantitative point of view, and the author reports on each haul under both these headings, illustrating the results in a table showing the relative frequency of each species in each haul. The same detail is observed in the presentation of the quantitative results, and this is followed by some short critical notes, descriptions of new forms, and varieties ; and finally there is a systematic list of all the species found, together with their geographical distribution and a reference to already existing figures.

French Peridinieæ.§—J. Pavillard publishes some supplementary notes on the Peridinieæ of the Gulf of Lyons and the Étang de Thau, near Cette. Among the species recorded, the following are new to science, and descriptions and figures of them are given—*Gonyaulax*

* Hedwigia, xlviii. (1909) pp. 153–5 (Beibl.).
† Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 210–14.
‡ Engler's Bot. Jahrb., xliii. (1909) pp. 225–302 (1 map and 2 pls.).
§ Bull. Soc. Bot. France, lvi. (1909) pp. 277–84 (5 figs.).

Kofoidi, *Peridinium formosum*, *P. Paulseni*, *Phalacroma hastatum*, *Dinophysis Schroederi*. In all, some eighty species have been collected in the Étang de Thau and Gulf of Lyons, a rich flora as compared with that of the English Channel.

Bacillariaceæ from South Patagonia.*—O. Müller gives a list of species collected by E. Nordenskiold and O. Borge in 1899 in South Patagonia, in ten different localities. Several new species and varieties are described.

Some New Chrysomonadineæ.†—A. Pascher, during his recent study of the micro-flora of Bohemia, paid special attention to the Chrysomonadineæ, and in the present paper he makes remarks on and describes six new species, belonging to four genera, *Chromulina*, *Chrysopyxis*, *Ochromonas*, and *Derepyxis*. He finds that very few of the Chrysomonadineæ are to be found in plankton, but that they prefer to live in former beds of streams and other undisturbed places which are becoming gradually filled up by their abundant marginal flora. They also like very clear, cold, rather shady springs or pools at an altitude of 500–1400 metres, which have never been disturbed for very many years. The paper concludes with a key to the species of *Derepyxis*.

Fertilisation in Zygnema.‡—P. A. Dangeard has studied the chromatic reduction in *Zygnema stellinum*, and gives his results in a short note. Both vegetative and reproductive filaments were examined. The first point of interest is the absence of chromatic reduction before fecundation. Vegetative mitoses, like those which directly precede the formation of gametes, show the same number of chromosomes; the author has regularly counted a dozen, be it at the prophase, at the stage of the equatorial plate, or at the anaphase.

The next points to be elucidated are:—(1) the formation of the egg, and (2) the aberrant forms of oospores. The distinction of the male and female filaments takes place fairly early. In the males, the axis, formed by the two chromatophores and the nucleus lies perpendicularly to the filament, and it preserves this position while advancing later into the canal. In the females, the chromatophores and the nucleus retain their normal position along the axis.

After the disappearance of the separating membrane of the copulative canal, the male gamete advances towards the female gamete, while preserving the same orientation; it is then that fecundation takes place. The anterior chromatophore moves away and the two nuclei, coming into contact, fuse rapidly. The oospore rounds itself off and becomes inclosed in a membrane which consists of cellulose endospore and a cutinised exospore. Details are given by the author as to the nucleus of conjugation and as to the behaviour of the nucleus in zygospores of irregular formation. Finally, the author states that this species shows all the stages between heterogamy, isogamy, and parthenogenesis, and

* Engler's Bot. Jahrb. Beibl., xliii. (1909) pp. 1–40 (2 pls.).

† Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 247–54.

‡ Comptes Rendus, cxlviii. (1909) pp. 1406–7.

constitutes an excellent example for the study of problems attaching to sexuality in general.

New Chlorophyceæ from California.*— N. L. Gardner has made a study of the minute algæ which form discolorations and mottlings of various kinds on the fronds of certain red and brown algæ along the Pacific coast. They are wholly or partly endophytic, or strictly epiphytic. In the present paper three new species are described, two of which form the types of new genera. They are—*Endophyton ramosum*, which grows inside the fronds of *Iridæa laminarioides* and *Gigartina radula*, and belongs to the family of Chroolepideæ ; *Ulvella prostrata*, which is strictly epiphytic on *Iridæa laminarioides* ; and *Pseudodictyon geniculatum*, which grows in abundance in the terminal part of the blade of *Laminaria Sinclairii*, and also belongs to Chroolepideæ. Figures are given of the new species.

Cladophora ægagropila.†—D. J. Scourfield publishes a short note on the globular form of this species, which he says he has seen floating in great numbers in the Norfolk Broads and waterways. Indeed, they sometimes form a positive hindrance to the passage of the wherries and other vessels. He mentions the tenacity of life which they possess, stating that he kept a specimen in a jar for nearly nine years before it decayed. During all that time, till within a month or two of the end, it maintained a green and healthy appearance, although it did not increase perceptibly in size. The author quotes the views of Dr. Wesenberg-Lund on these balls, and adds the information that in some parts of the country where they occur the children use them as sponges to clean their slates.

Two New Members of Volvocaceæ.‡—B. M. Griffiths decribes two new fresh-water algæ from Stanklin Pool, near Kidderminster. The pool is a very old one, and is fed by bottom springs ; it has yielded a number of interesting algæ. The first novelty is *Pyramimonas delicatulus*, and it occurred in great abundance in the autumn of 1908. It is the first member of Polyblepharideæ to be recorded for the British Isles. It moves at considerable speed through the water, and appears to swing from side to side as it moves. Its four cilia are strong and thick, and do not taper, but appear to end abruptly. Division takes place by longitudinal fission, and the process is described in detail. No encysted state was observed. *P. delicatulus* is very susceptible to adverse conditions, and attempts to make cultures, either in the original water or with Knop's solution, were unsuccessful. All attempts at preserving this alga in solutions of 4 p.c. of formalin, or under, proved disastrous ; the cell-membrane became swollen out into great blisters, and eventually the chloroplast became a shapeless green mass. On the other hand, if strong formalin be used no such effects are produced. A solution of 20 p.c. formaldehyde causes no distortion

* Univ. California Publications (Bot.) iii. (1909) pp. 371-5 (1 pl.).
† Essex Naturalist, xv. (1908) pp. 180-1.
‡ New Phytologist, viii. (1909) pp. 130-7.

beyond a very slight shrinkage of the cell. The other species referred to is a doubtful form of *Chlamydomonas*, the most prominent characteristic of which is a distinct, well-marked channel running up through the transparent "beak" ("Hautwatz"). The two cilia are not easy to see, even after staining.

New Siphoneous Alga.*—A. and E. S. Gepp publish a diagnosis of a new species of *Udotea*, *U. verticillosa*, which occurs in the West Indies and is most nearly allied to *U. argentea*. It was collected by the 'Challenger' Expedition.

Fucus spiralis.†—F. Börgesen deals very fully with the question of nomenclature regarding *Fucus spiralis* L. and *F. platycarpus* Thuret. Professor Sauvageau takes the view that *F. spiralis* was not sufficiently defined by Linnæus, and that it included a form of *F. vesiculosus*, viz. f. *sphærocarpa*. Börgesen, on the other hand, takes the view that the original diagnosis of Linnæus is quite clear, and refers to it the plant later named *F. platycarpus* by Thuret. He further states that the differences which induced Thuret to regard his plants as constituting a new species are really nothing but modifications according to the latitude in which *F. spiralis* grows. Even among his Faeroese material he finds occasional plants or portions of plants, which remind him strongly of *F. platycarpus*; and his opinion is that Thuret's *F. platycarpus* is a more southerly variety of *F. spiralis*, while the typical form occurs more particularly in the northern regions, but may also be found growing together with var. *platycarpa* in the southern. This opinion he states in his Botany of the Faeroes, and he has seen no reason to depart from it since. The views, therefore, of Börgesen and Sauvageau are opposed, since Börgesen considers the species is *F. spiralis* with var. *typica* Börgs. (= f. *typica* Börgs.), with f. *limitanea* Mont. (= f. *nana* Kjellm. (Börgs.), and var. *platycarpa* Thur. (Börgs.), while Sauvageau thinks that the species is *F. platycarpus* Thur., with var. *spiralis* Sauvag. The author goes on to describe the specimens of *F. spiralis* in Herb. Linné, and these are also represented in photographs. As to the differences which distinguish *F. spiralis* and *F. inflatus*, the author finds that, though the species may be confused in herbaria, they are easily recognised in the open, as *F. inflatus* grows on sheltered coasts at about low-water mark, while *F. spiralis* L. occurs at about high-water mark. Finally, the views of other authors, both old and modern, are discussed.

Zoning of Brown Seaweeds.‡—S. M. Baker discusses the causes of the zoning of brown algæ on the seashore. In order to have a clear understanding of the conditions under which the algæ were growing at a particular locality (near Bembridge, in the Isle of Wight), the author took a set of measurements to find their vertical distribution in relation to the tides. The methods of work are described, and a table is given showing the upper and lower limits, and the mean readings of five species and of the Laminarias. Three phases of the life-history of

* Journ. of Bot., xlvii. (1909) pp. 268–9.
† Journ. Linn. Soc. Bot., xxxix. (1909) pp. 105–19 (1 pl. and figs. in text).
‡ New Phytologist, viii. (1909) pp. 196–202 (diagram and figs.)

the plant are mentioned, which may be influenced by drying, viz. :—(1) germination of the zygote; (2) vegetative growth; (3) reproduction and dispersal of the gametes. Several of the common species of Fucoideæ were grown also in jars of sea-water, in which, for a certain number of hours daily, the water was removed, in order to reproduce their position with regard to tide-levels. The results of the experiments are described, and the following conclusions are drawn :—1. That the species of seaweeds growing high up on the shore have a power of resisting desiccation, which is not possessed by those growing lower down, and that this power decreases regularly in those species growing towards the lower levels. 2. That the seaweeds which can best resist desiccation grow most slowly, and that those that grow most quickly are the least tolerant of desiccation. In the lower zones, the primary factor is probably rate of growth; the quickest forms would supersede the others. In the upper zones, the determining factor is tolerance of desiccation. Other possible factors are suggested.

Sphæranthera lichenoides.*—F. Heydrich adds further details as to the formation of spores in *Sphæranthera lichenoides*, on points which he had been obliged previously to leave somewhat obscure. He finds that the sporogenous nucleus emerges from the carpogonium and enters into a row of cells prepared before fertilisation, which lie under the procarpia; the nucleus traverses these cells, which have become disintegrated, and, uniting with another nucleus either at the margin or in the centre, becomes a spore. As in all other Florideæ, each procarp is fertilised separately, from which again each single cell undergoes fusion either (1) with the cell of the same filament lying immediately below it; or (2) with a cell on the neighbouring dichotomy of the same filament; or (3) with a cell of another filament; thereby producing spores. Since many such organs occur inclosed in a special cavity, the author forms three divisions on this character :—1. Corallinæ-Actinococcales with the genera *Eleutherospora*, *Stichospora*, and *Perispermum*. 2. Corallinæ-Rhodymeniales with the genera *Sporolithon* and *Paraspora*. 3. Corallinæ-Cryptonemiales with the genera *Sphæranthera*, *Stereophyllum*, *Epilithon*, and *Mastophora*..

Californian Species of Crustaceous Corallines.†— M. B. Nichols continues his contributions to the knowledge of the Californian crustaceous Corallines. In a previous paper (1908), the author gave the results of his study of *Lithothamnion mediocre* Foslie and Nichols, one of the most common of the epiphytic forms. In the present paper he takes up a group of epiphytic forms, including *L. marginatum* Setchell and Foslie, *Lithophyllum macrocarpum* f. *intermedia*, forms of *L. pustulatum* and of *L. tumidulum*. He then discusses briefly some of the characters which have been used as the basis for the separation of the genera *Lithothamnion*, *Lithophyllum*, and *Melobesia*, particularly those characters given by Foslie (1900). Since the latter author has placed the greatest emphasis on the differences in the structure of the

* Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 234–38 (1 pl.).
† Univ. California Publications (Bot.) iii. (1909) pp. 349–70 (4 pls.).

tetrasporangial conceptacles, the discussion in the present paper is confined largely to the consideration of some points in connection with the structure of these conceptacles.

Marine Algæ of Denmark.* —L. K. Rosenvinge publishes the first instalment of his exhaustive and important work on the marine algæ of Denmark. It is based on collections of his own begun in 1890, on collections sent to him by other people, and on those preserved in herbaria. The Danish waters have been most carefully examined and worked as far east as the boundary of the region investigated by Reinke, and details are given in the introduction concerning the conditions of depth, the nature of the bottom, and the salinity and temperature of the sea water in the many parts of the much broken coast line. The author undertook a good deal of dredging, and devotes a chapter to remarks on the dredging localities. This is followed by a list of stations arranged according to the different waters, with notes as to the depth of water and an indication of the most common and predominant species. In the present part of the work the author treats only of the Bangiales and Nemalionales. In addition to giving the distribution of each species in Denmark, each record is followed by critical notes which embody interesting personal observations on the manner of growth, the development, life-history, and structure, and the views of other authors. The following new genera are described :—*Porphyropsis* (= *Porphyra coccinea* J. Ag.) ; *Erythrocladia* (an ally of *Erythrotrichia*), containing two new species ; *Kylinia* (somewhat resembling *Chantransia*), with one species. The genus *Chantransia* contains 24 species, of which 16 are new ; and the notes are so complete, and deal so fully with the life-history and the systematic position of each species, that the treatment of the genus constitutes a monograph in itself. A key to the species of *Chantransia* is given, and they are divided under two subgenera. The author has discovered tetrasporangia in five species over and above what was already known, and his notes on the reproductive organs are extremely interesting. Some of the species are partly endophytic. The whole work is well illustrated, and charts are given of the Danish waters, with curves of depths and dredging places.

New Zealand Marine Algæ.† — A. D. Cotton publishes some interesting notes on nine species of New Zealand algæ in the Kew Herbarium. They are: *Myrionema strangulans* Grev., *Leathesia difformis* Aresch., *Petrospongium Berkeleyi* Naeg., *Dictyota ocellata* J. Ag., *Callophyllis Hombroniana* Kütz., *Chrysymenia asperata* Cotton (= *Callophyllis asperata* Harv. and *Chrysymenia* (?) *apiculifera* J. Ag.,) *Nitophyllum variolosum* Harv., *N. uncinatum* J. Ag., and *Aphanocladia delicatula* Falkenb.

Algæ of the Tatra Mountains.‡—R. Gutwinski publishes a complete flora of the Tatra Mountains, in which he records 827 species and varieties. The first part of the paper is devoted to (1) a consideration of the geographical position of the region and its geological composition ;

* Kgl. Danske Vidensk. Skrifter, ser. vii., 7 (1909) I., 151 pp. (2 charts, 2 pls., and figs. in text). † Kew Bulletin, 1909, pp. 239–43.
‡ Bull. Internat. Acad. Sci. Cracovie, 1909, pp. 415–560.

(2) a review of past work, with a list of localities where former collections have been made ; and (3) a list of the localities worked by the present author, with notes as to the predominant species occurring at different levels. The paper is illustrated by two plates, and these are followed by a list of bibliography.

Algæ of Bremen.*—F. Hustedt is working out the algal flora of Bremen, and found the canal connecting Bremen with the neighbouring fens to be rich in diatoms. He collected them for a full year. After preliminary remarks on the topography of the canal, the colour and temperature of the water, the frequent occurrence of certain species (including some marine forms), etc., he describes the composition of the plankton month by month, and gives complete lists of 53 species of algæ and 174 forms of diatoms.

Algæ of Iowa.†—R. E. Buchanan gives a list of the algæ of Iowa, with keys of the orders, families, subfamilies, genera, and species. He records 181 species, with their localities. Iowa is pre-eminently a prairie state, and the streams and lakes form but a very small proportion of its area. The present list is compiled from specimens collected at many different parts of the state, but there is still much material to be worked through, and the list does not pretend to be complete in any way. One of the groups of algæ having the widest and most general distribution is the Diatomaceæ, which will amount in the complete list to some hundreds of species. Next in abundance come the Myxophyceæ. Of the genus *Spigogyra* twenty-five species are recorded.

African Algæ.‡—G. S. West publishes two papers on African algæ, the first on the algæ of the Birket Qarun, Egypt, and the other on phytoplankton from the Albert Nyanza.

The collections from the Birket Qarun were made by Cunnington. The Birket Qarun is a shallow lake, some 25 miles in length by 5 or 6 miles in breadth, and is situated in the Fayum province of Egypt. It communicates with the Nile, and the water is brackish. Algæ were collected from the shores and from ponds, swamps, and stagnant pools near the shores, and from the inlets. The total number of species collected is 66, and the author attributes the small total to the brackish character of the water. The Chlorophyceæ are poorly represented ; the Myxophyceæ and Bacillarieæ are more numerous, the respective number of species being 14, 19, and 32. Two marine species were found, *Polysiphonia utricularis* Zan., and a form of *Enteromorpha plumosa*. The majority of the algæ were brackish-water forms, the only fresh-water species being obtained from near the mouth of the Wady. Remarks are made on the littoral alga-flora and on the plankton, which was mostly animal. Two new species of algæ are described.

The phytoplankton from the Albert Nyanza was collected by R. T. Leiper, and contained 48 species, none of which could be regarded as dominant. About two-thirds of them also occurred in a collection from near the bottom. A list follows, in which two new species are described.

* Abhandl. Nat. Verein Bremen, xix. (1909) pp. 418–52 (12 figs.).
† Proc. Iowa Acad. Sci., xiv. (1909) 40 pp.
‡ Journ. of Bot., xlvii. (1909) pp. 237–46 (1 pl.).

Nomenclature of Algæ.* — The botanists of the British Museum publish a motion which they have sent in for consideration at the Brussels Congress of 1910, wherein they suggest that the starting point for the nomenclature of algæ should begin with the Systema Algarum of C. A. Agardh. Their reasons are stated.

Amœboid Movements in Algal Spores.†—A. Pascher describes remarkable amœboid stages in one of the higher green algæ, that is to say, an alga belonging to the Tetrakontæ Ulotrichales, and closely related to *Aphonochæte*. He states that amœboid stages occur not only in the gametes of heteromorphous sexual cells and tetraspores and zygotes, but also in the original primary products of reproduction—the macrospores or vegetative swarm-spores. He watched the whole process. The green amœboid spore was produced, and extruded with its four cilia, its vacuole and eye-spot, and after a very brief and clumsy swarming it lost its cilia and began to creep with amœboid movements for $\frac{1}{2}$ to $\frac{3}{4}$ hour, and then settled and germinated in the ordinary way.

Movements of Low Organisms at Low Temperatures.‡ — E. C. Teodoresco publishes an account of his researches on the locomotive movements of the lower organisms at low temperatures. He gives a résumé of the results of other authors, and describes his own methods of research and the chilled box in which he inclosed his Microscope. He had the following organisms among others under observation:—*Hæmatococcus pluvialis*, *Chlamydomonas Pertyi*, *Chloromonas reticulata*, *Gonium pectorale*, *Polytoma uvella*, *Peridinium tabulatum*, *Cryptomonas erosa*, *Eutreptia viridis*, *Euglena viridis*, *E. pisciformis*, *Dunaliella salina*, *D. viridis*, *Cymbella cistula*, *Fuligo septica*, and some Infusoria, etc. He gives the results of his observations in each case. He finds that the lower temperature limit at which locomotion is possible in these unicellular organisms is much below what had been supposed. The greatest resistance to cold was shown by the zoospores of *Dunaliella*, their movements only ceasing between $-17°$ and $-22 \cdot 5°$ C. In others, the lower limit varies between $-5°$ and $-12 \cdot 7°$ C.; but it varies in individuals of the same species. Most organisms cease their movements at about zero.

Collections of Algæ in the New York Botanical Garden.§ M. A. Howe gives an account of the collections of algæ preserved in the herbarium of the New York Botanical Garden. The collections include a number of specimens of historical interest sent to Professor John Torrey by J. W. Bailey, C. A. Agardh, and others; also T. F. Allen's Characeæ; 1400 specimens of marine algæ collected by G. W. Perry; 2500 specimens from H. Averill; 3000 specimens in the Pike collection, which is specially rich in Mauritius material; the C. L. Anderson collections, numbering some 4000 specimens; and the algæ collected in late years by M. A. Howe himself in the West Indian region, Nova Scotia and Newfoundland. A short account is also given of the exhibition cases being gradually prepared for the public gallery of the Gardens.

* Journ. of Bot., xlvii. (1909) p. 309.
† Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 143–9 (pl.).
‡ Ann. Sci. Nat., sér. ix., 9 (1909) pp. 231–74.
§ Journ. New York Bot. Garden, ix. (1908) pp. 123–30 (figs.).

Henri van Heurck.*— J. Chalon publishes an obituary notice of the late Professor H. van Heurck, who died last March at Antwerp, aged 71 years. He gives an account of his collections of drugs, Microscopes, diatoms, algæ, phanerogams, physical instruments, etc. One of the unique treasures is Möller's famous type-slide containing 4026 species of diatoms arranged in perfect order within a square of 6 mm. diameter. It cost 40*l*.; and it occupied Möller forty full days to place the diatoms in position. From 1864–99 van Heurck was Professor of Chemistry at the School of Industry at Antwerp. Placed in charge of his father's factory of paints and varnishes, he invented certain varnishes and lacquers which have stood the lapse of time remarkably well. He prepared and patented the dentifrice Odol. In 1876 he was appointed professor for life at the Antwerp Botanic Garden. A long list of his publications is given. The proofs of his last work—on the Diatoms collected by the 'Belgica' Antarctic Expedition—he finished correcting on his death-bed.

Fungi.

(By A. Lorrain Smith, F.L.S.)

Chrysophlyctis endobiotica.†—T. Johnson and F. Weiss have published an account of the germination of the so-called spores of *Chrysophlyctis* in successive papers. The spores germinated in potato-juice, and proved to be zoosporangia full of zoospores, seen in active motion before escaping through a slit in the wall of the sporangium. Weiss adds that the zoospore stage is followed by an amœboid stage. Finally, the pseudopodia are withdrawn, and the organism comes to rest, taking a spherical form.

Chrysophlyctis endobiotica and other Chytridiaceæ.‡—T. Johnson has followed the germination of the resting sporangium or "spore" of *Chrysophlyctis*, the walls of which split, allowing the escape of the zoospores. A new infection takes place by the penetration of these zoospores from the soil or by the internal passage of plasmodium from diseased tubers used as seed to the new tubers. Notes are also given on *Urophlyctis leproides*, a disease of the beet, and on *Asterocystis radicis*, which attacks the root-hairs and roots of flax plants. It also occurs on the roots of grasses and of weeds in the flax-field. A number of Chytridiaceæ live on algæ, and are briefly commented on by the author.

Notes on Mucor.§—L. Raybaud has been experimenting on *Mucor*, to test the influence of osmosis and of transpiration on the morphology of the organs. On juice of orange, and in damp conditions, when more moisture was supplied the mycelium increased its dimensions, and finally burst, with the escape of the protoplasmic contents ; when it did not burst, swellings were formed on the hyphæ and the formation of sporangia was arrested.

In the case of accelerated transpiration, a current is set up towards

* Bull. Soc. Roy. Bot. Belg., xlvi. (1909) 31 pp. (3 pls.).
† Nature, lxxix. (1908) pp. 67 and 98.
‡ Proc. Roy. Dublin Soc., xii. (1909) pp. 131–44 (3 pls.).
§ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 1118–21.

the tips of the hyphæ, with an accumulation of protoplasm and abundant sporangial formation. In moist conditions Raybaud also noted that the spores found were fairly equal in size; in dry air they varied considerably. In moist air they were of a grey hue; in dry air they were a golden colour.

Studies in Pyrophilous Fungi. I.*— F. J. Seaver includes under this designation the fungi that grow by preference on charcoal or burnt ground, and his first paper deals with *Pyronema omphalodes*. He makes a series of observations on the conditions most favourable to the growth of this fungus. It develops equally well on recently burnt ground, soil sterilised by steam, or on agar. It appears very quickly after burning of the ground before any other vegetation has time to grow. Seaver quite failed to grow it on unsterilised soil. Sterilisation of the soil, he considers, brings about some change other than the simple elimination of bacteria, which is all-important to the growth of pyrophilous fungi. Notes are given as to culture methods.

New Genus of Ascomycetes.†—The fungus now described, *Gibsonia phæospora* g. et sp. n. was found by R. J. Harvey-Gibson on material that was blocking the drains on an estate near Preston, and which consisted largely of Saprolegniaceæ. The above fungus was also found, and was submitted to G. Massee, who gives a diagnosis of genus and species; it is almost the exact parallel of *Spumatoria* Mass. & Salm., in the Hyalosporæ.

Structure and Affinities of British Tuberaceæ.‡ — G. Massee describes the development of the sporophore of these underground fungi, from their origin as a minute ball growing from a weft of mycelium. The peripheral hyphæ form the cortex, and if they cease growing at an early stage, the pressure from within results in the breaking up of the superficial layers and the formation of a warted outer wall. When the spores are mature, the asci deliquesce and the spores lie in the cavity free. All of the Tuberaceæ have a strong odour, which attracts rodents. Massee looks on the Tuberaceæ as an ancient group of fungi which preceded the Discomycetes, and he traces through several genera the opening of the peridium—at first by a small opening at the apex, finally the cup-shaped disk of the *Pezizæ*. The spores in the Tuberaceæ are large and often ornamented with lines, warts, etc., contrasting thus with those of the Discomycetes, which are small and adapted to wind-dispersal. There are in Britain 11 genera and 32 species. The total number of known genera is 27, with 140 species.

Morphology and Cytology of Aspergillus repens.§—Elizabeth Dale gives first of all an historical sketch of work done on *Aspergillus*, and then fully describes the species *A. repens*, contrasting and comparing it with *A. herbariorum*, from which it differs both in the conidial and fruit forms. The fungus was cultivated on beer-wort in 2 p.c. agar-agar. It was found that the archicarp arose as a slender branch, becoming tightly

* Mycologia, i. (1909) pp. 131–39 (4 pls.).
† Ann. Bot., xxiii. (1909) pp. 335–6 (3 figs.).
‡ Tom. cit., pp. 243–63 (1 pl.).
§ Ann. Mycol., vii. (1909) pp. 215–25 (2 pls.).

coiled or remaining irregular and loose; in many, if not in most cases, there was no antheridium, but when present it was developed at an early stage; in no case was any fusion observed between ascogonium and antheridium. The ascogonium is multinucleate, and these nuclei fuse in pairs, representing a reduced form of sexuality; a second fusion takes place in the young ascus.

Development of Genea Thwaitesii.*—Ed. Fischer writes a paper on the affinities of this interesting Ceylon fungus. He finds that the parenchymatous sheath covering the hymenium is formed of the tips of the paraphyses, and, following this clue, he places the fungus among the Pezizaceæ. He compares this epithecial layer with that formed in other Ascomycetes.

Endomyces.†—W. Dombrowski describes in considerable detail the development of *Endomyces fibuliger*, the fungus that forms white, chalk-looking spots on bread. The fungus increases by budding, and forms endospores similar to the ascospores of *Saccharomyces*, but it differs from true yeasts in the formation of considerable mycelium and also in the power of the spores to germinate by producing a filament as well as by budding. The endospores, as a rule, are formed in cells budded off from the hyphæ, but occasionally they are formed in intercalary cells of the filament itself.

A new species of the genus *E. javanensis*, which occurred in soil from Java, has been studied and described by A. Klocker.‡ It differs from *E. fibuliger* in the form of the spores, which are finely warted. They increase by budding or by a germinating filament.

A. Guilliermond § also publishes a note on *E. fibuliger*, comparing and contrasting it with *Eremascus fertilis*. He finds that the two genera are very closely allied, but in *Endomyces* there is an abundant formation of yeast-cells, linking it to *Saccharomyces*. He also describes in *E. fibuliger* an attempt at conjugation: two cells, which he terms gametes, are formed and lie close together, but they never fuse, and one or both become asci. Guilliermond sees in this a vestige of sexuality.

In another paper ‖ he discusses the phylogenesis of the yeasts. He considers that *Saccharomyces* and *Schizosaccharomyces* are derived from a genus akin to *Eremascus fertilis*. From that ancestor there are two branches: one represented by *Endomyces Magnusii* and the Schizosaccharomycetes, the other by *Endomyces fibuliger*, *Zygosaccharomyces* and *Saccharomyces*.

Byssochlamys nivea g. et sp. n.¶—Rich. Westling describes this new Ascomycete which he found growing on plants that had been kept in methylated spirits. There was first a vigorous growth of mycelium with chlamydospores, and at a later stage asci. The chlamydospores resemble those of *Endomyces decipiens*, the conidiophores those of

* Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 264–70 (1 pl.).
† C.R. Lab. Carlsberg, vii. (1909) pp. 247–66 (10 figs.).
‡ Tom. cit., pp. 267–72 (3 figs.).
§ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 925–7.
‖ Tom. cit., pp. 998–1000.
¶ Svensk. Bot. Tidssk., iii. (1909) pp. 125–37 (1 pl.). See also Ann. Mycol., vii. (1909) pp. 306–7.

Gymnoascus flavus. The author found a coiled ascogonium at the beginning of fruit development, but he did not detect either an antheridium or any kind of fusion. There was no kind of peridium formed. He places it near to *Endomyces.*

Saccharomycetes.*—Two new genera of yeast are described and figured by A. Klocker: *Debaryomyces*, of which the spore has only a single membrane and is finely warted; and *Schwanniomyces*, of which the spores have also a single membrane and are warted, but are, in addition, finely reticulated. In the latter one half of the spore swells and gives rise to the new budding; very often the first budded cell is slightly elongated. In both of these genera the warted surface becomes smooth as it swells to form the new cell.

Influence of Humus on the Development of Yeast and on Alcoholic Fermentation.† — A. Dzierzbicki found that if a small quantity of sterilised soil were introduced into yeast cultures, the effect was favourable to the development of the yeast, and he ascribed the result to the presence of humus in the soil. It is particularly noticeable when there is a very small quantity of yeast in the culture. The effect is not entirely due to the added nutritive qualities of the humus, but also probably to the development of *Azotobacteria* and of nitrogen fixation.

Hyphomycetes.‡—Considerable progress has been made by Lindau with his work on the Hyphomycetes. The present fascicle is largely occupied with the genus *Fusarium*, of which ninety-five species are described; most of these are saprophytes, but there is a considerable number that attack living plants and do great damage. They are all distinguished by the sickle-shaped, colourless, septate spores.

Infection of Split Cod by Torula epizoa.§—This fungus is a troublesome pest in the process of salting and drying cod. K. Höye attempted to lessen the evil by using different salts, and by altering the process of drying. None of his experiments were successful. He is of opinion that the *Torula* takes rise in the salt-stores, which are never thoroughly overhauled and disinfected, and the fungus grows with especial rapidity if flour or any similar substance is spilt. The *Torula* forms black spots on the split-cod, rendering it very unsightly.

International Statistics of Cereal Rusts.‖ — Paul Sorauer has undertaken this work as a starting point for other contributions on plant diseases as they occur in various countries. In connection with rust disease he raises six points of inquiry:—1. Incidents which illustrate the varying intensity of disease in the same neighbourhood. 2. Examples of various factors that aid in the dissemination of the rust fungus. 3. Undoubted connection between weather conditions and rust disease. 4. Influence of locality and soil on the outbreak of cereal

* C.R. Lab. Carlsberg, vii. (1909) pp. 273–8 (6 figs.)

† Bull. Int. Acad. Sci. Cracovie, iv. (1909) pp. 651–60.

‡ Rabenhorst's Kryptogamen-Flora, i. 9te Abt., Lief. 113 (Leipzig, 1909) pp. 497–560.

§ Berg. Mus. Aarbog (1908) 29 pp. (10 pls.). See also Bot. Centralbl., cx. (1909) p. 627.

‖ Zeitschr. Pflanzenkr., xix. (1909) pp. 193–286.

rust. 5. Influence of cultivation on the intensity of the outbreak. 6. Individual or race character of the grain in reference to sensitiveness to attack. Sorauer discusses the questions raised under these headings, and finally sums up that rusts can be overcome only by selecting plants that are immune to attack, and by cultivating such races as are able to withstand the disease.

Notes on Smut.*—L. Hecke has carried on experiments for four years to test the influence of temperature or of race on the frequency of smut. With regard to summer wheat, the results were so varied that no race influence could be formulated; with winter wheat results were more definite, and pointed to the greater immunity of certain strains. Hecke found that with low temperatures there was more liability to smut. In favourable conditions of warmth, etc., the wheat plant grows quickly, and soon passes the season of greatest susceptibility.

Notes on Harmful and Interesting Fungi.†—E. Pâque records his observations on the gradual destruction of an oak tree by the fungus *Fomes igniarius*. The stem of the tree was broken at the point of attack, and showed the symptoms of white rot. He describes also the effect of *Armillaria mellea* on other trees: the rhizomorphic strands take possession of the cambial region, and gradually the tree succumbs.

A note is added on the culture of *Sphærobolus stellatus* under a bell-jar, and of its method of ejecting spores.

Distinctive Characters of the Mycelium of Merulius lacrymans.‡ J. Beauverie undertook a study of this fungus, the dry-rot of houses, to find if possible some sure method of recognising its presence in wood. He describes the clamp connections of the hyphæ, and the rhizomorphic strands which are peculiar to *Merulius* but unfortunately not always present. He also studied the nuclei, but they afforded no help in diagnosing the mycelium.

Dry-rot.§—Richard Falck has continued his study of the occurrence of dry-rot in wood by examining the types of mycelium belonging to the different fungi that attack timber, and he finds certain characters that might be helpful in determining the fungus. He recommends various methods of destroying the fungus: the true dry-rot of houses can be destroyed by heating the timber to 34° C.

In another paper‖ he discusses the same subject. Wood may be attacked in two ways: the mycelium may form a felt on the surface of the wood and gradually penetrate inwards, or the mischief may begin in the interior of the wood and work outwards; the latter course is followed by species of *Lenzites*. Infection takes place always by spores; they are carried by the wind into cracks of the wood, and, given sufficient

* Zeitschr. Landw. Versuch. Oesterr., xii. (1909) pp. 49–66. See also Ann. Mycol., vii. (1909) pp. 307–8.
† Bull. Soc. Roy. Belg., xlv. (1908) pp. 354–7.
‡ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 840–2.
§ Pharm. Zeit., No. 95 (1908) 4 pp.
‖ Jahresber. Ver. Ostdeutsch. Holzhändler Holzind., Berlin, 1908, 18 pp. See also Hedwigia, Beibl., xlviii. (1909) pp. 172–4.

moisture, they germinate and grow. The author describes the appearance and effect produced by *Lenzites* on the timber, and then discusses the possibility of killing the fungus.

Notes on the Higher Fungi.* — R. Scharfetter gives an account of a fungus exhibition held at Villach, in Carinthia, and then discusses various points of interest in connection with the fungi. 1. The dissemination of spores by wind or by animals; snails eat the spores, insects carry them about. 2. Animals are attracted by colour, odour, and by the milky juice. 3. Protection against undesired animals is afforded by chemical means—poisons, etc.—and by mechanical spines, suberisation, mucilage formation, etc. 4. Habitat of fungi; the numbers in mixed wood are as 3 to 5 in pine wood.

New Genus of Thelephoreæ.†—W. Brinkman makes *Thelephora pallida* the type of a new genus, *Bresadolina*, on account of the smooth colourless spores and cystidia—differing thus from *Thelephora*, all the species of which have brown, echinulate spores.

Development of Crucibulum vulgare.‡—M. Molliard took the peridiola of this fungus before they were quite mature, and sowed them on various sterilised substrata—carrot, wood, etc. In closed tubes he obtained only mycelium, but in larger vessels, after two and a half years, the filaments more distinctive of *Crucibulum* began to be formed, finally the complete plant, entirely normal. One series of plants were grown on cloth made of *Phormium tenax*, and Molliard was able to demonstrate in that case that the fungus had digested the lignin of the fibres without the aid of any other organism, such as bacteria.

Variation of Fungi due to Environment.§ — F. L. Stevens and J. G. Hall have proved this variability by making a series of cultures of species belonging to the genera *Septoria*, *Ascochyta*, *Volutella*, and *Sclerotinia*. They note the behaviour of these on different substrata, and deduce from their experiments the necessity of cultures in diagnosing fungi. These should be carried out under suitable standard conditions, much after the fashion that bacteria are now studied.

Method of Sending Pure Cultures of Fungi.||—A. F. Blakeslee draws attention to the trouble experienced when cultures of fungi become contaminated with weed-fungi in tubes, owing to the shaking up of the culture during transmission by post, and the consequent growth of foreign fungi, the spores of which may have been in the cotton plug. He recommends hard agar in the tubes, or, as a simple expedient, taking a sample of the mycelium with sterilised forceps and inclosing it in small paper envelopes, such as are used by druggists in putting up powders. This method has been employed by him for a number of years, and with invariable success.

* Carinthia, II., xcviii. (1908) pp. 106–26. See also Hedwigia, Beibl., xlviii. (1909) pp. 163–4.
† Ann. Mycol., vii. (1909) pp. 288–9.
‡ Bull. Soc. Bot. France, ix. (1909) pp. 91–6 (1 fig.).
§ Bot. Gaz., xlviii. (1909) pp. 1–30 (37 figs.).
|| Science, xxvii. (1908) pp. 960–1.

Fungal Parasites of Men and Animals.*—Henri Coupin has published an atlas reproducing the figures of all the microscopic fungi that have been known to cause disease or to infect living beings. It is intended as a useful book of reference for doctors and veterinary surgeons, and will also be helpful to botanists. The text is confined to descriptions of the plates, with a note as to the habitat of the fungus figured. Coupin has added drawings of the higher fungi that are poisonous or suspect as articles of food. A good index completes the volume.

Value of Chemotropism in the Parasitism of Fungi.†—L. Petri made a series of experiments with *Sclerotinia Libertiana*, to determine the true nature of resistance to the parasite in the higher plants. He carried out these experiments on various grasses, and describes his methods and the tissues after the various attacks induced by infection. He found that some grasses present a natural immunity against *S. Libertiana*, though that does not imply an immunity against the cytases elaborated by the fungus. Such immunity is based on certain contents of the cell, which exercise a stimulus of chemotropism against the parasite; the fungus provokes in it a formation of cytase and of potassium oxalate, and that in turn reacts on and conquers the resistance of the host-cell.

Gall-fungi.‡—L. Petri has made a series of observations on the galls formed by *Phylloxera*. He finds in the gall several species of fungi growing on the gall tissue, and probably of service as food for the larvæ, but he also finds certain fungi parasitic on and killing the *Phylloxera*; eggs and larvæ, as well as the perfect insect, are attacked. The harmless gall fungi are forms of *Ramularia*, *Torula*, *Hormodendron*, *Fusarium*, and *Dematium pullulans*. Those living on eggs and larvæ belong to other genera. Among them he has isolated species of *Acremonium*, *Cladosporium*, *Hormodendron*, *Oospora*, *Alternaria*, *Macrosporium*, and *Nectria*. Petri describes these fungi: many of them he considers live only on the dead eggs or larvæ, and have not attacked the living organisms. The author discusses the action of the *Phylloxera* and of the fungi on the leaf.

Freezing Tests with Aspergillus niger.§—It has been stated that a close connection exists between high osmotic pressure in plant cells and death by freezing. N. Maximow experimented on *Aspergillus niger* to test this statement. He grew two plants, one with a high percentage of glycerin, or sugar, solution in the culture; the other was grown as a control culture. After growth was well developed they were reduced to a low temperature, and the carbonic acid given off was carefully observed. Freezing took place at a higher temperature than ice formation. Other results were noted, but chiefly that the osmotic condition of the cells has no connection with the fatality due to freezing.

* Atlas des Champignons parasites et pathogènes de l'Homme et des Animaux. Paris: Octave Doin et Fils (1909) 137 pp. (58 pls.).

† Atti Reale Accad. Lincei, cccvi. (1909) pp. 545–53.

‡ Ann. Mycol., vii. (1909) pp. 254–73 (9 figs.).

§ Journ. Bot. éd. Sect. Bot. Soc. Imp. Nat. St. Petersbourg, 1908, pp. 32–46. See also Bot. Centralbl., cx. (1909) pp. 597–8.

Fossil Fungi.*—P. H. Fritel and R. Viguier, in the course of their study of fossil Equisetaceæ, discovered the mycelium of a hyphomycetous fungus in the rhizome of *Equisetum noviodunense*. There were spores attached to the filaments, which enabled them to identify and name it as *Clasterosporium eocenicum*. The authors could not determine if the fungus were parasitic or merely saprophytic in a decaying plant. Another fungus associated with the same mycelium, though evidently distinct and quite different, was also noted: it formed spherical bodies, inclosing spores which might represent a sporangium.

J. Schuster † publishes palæobotanical notes from Bavaria, and gives his observations on fungal products that he observed in the fossil woods. In *Pinus excelsa* and *P. silvestris* he found a well-developed *Rosellinia* or *Rosellinites*, with perithecia and spores.

Chitin in Boletus edulis.‡—By the use of reagents, potash, acids, etc., E. Scholl has succeeded in demonstrating the presence of chitin in fungi resembling chemically the chitin of animals. The author describes the various processes by which he tested the existence and the quality of this substance, and he considers that De Bary's term fungus-cellulose should be dropped in favour of the word fungin, as understood by Breconnot. Scholl intends to carry further the research so successfully begun.

Cellular Membranes of Fungi.§—C. Ilikevic differs from other workers as to the constitution of hyphal membranes. He finds that the cell-walls are not formed of chitin, as has been generally held, but of a nitrogenous substance akin both to cellulose and to chitin, which he names "mycosin." The substances composing the cell-wall belong to a special group, which he classes as mycetin, and thus avoids the employment of terms such as fungus-cellulose, etc., which are misleading.

Fungus-spores present in the Air.‖—O. Rostrup has investigated this subject recently by exposing sterilised gelatin for a given time (15 minutes) to the air. In this manner seventy-eight tests have been made during the course of three years. Rostrup found that the largest number of spores were those of Hyphomycetes; the next most numerous were the Mucoraceæ. More infections took place in the open than within doors, possibly due to the greater agitation of air. *Penicillium glaucum*, however, was in greater abundance in rooms. A new species, *Citromyces tubifer*, was isolated, and is described.

Filling Tree-cavities.¶—J. J. Levison recommends very strongly that tree-wounds should be carefully plugged and closed over after cutting away all the diseased portions, and painting the uncovered wood with white paint. It is advisable to mix some charcoal with the filling used, as it acts as an antidote to fungi.

* Rev. Gen. Bot., xxi. (1909) pp. 143–6 (3 figs.).

† Ber. Bayer. Bot. Ges., xii. (1909) 2 pls. See also Ann. Mycol., vii. (1909) pp. 309–10.

‡ SB. Akad. Wiss. Math.-Nat. Kl., cxvii. (1908) pp. 547–60.

§ Bull. Acad. Imp. Sci. St. Petersbourg, vi. sér. 2 (1908) pp. 571–88. (Russian.) See also Bot. Centralbl., cxi. (1909) p. 103.

‖ Dansk. Bot. Tidsskr., xxix. (1908) pp. 32–41. See also Bot. Centralbl., cxi. (1909) p. 104.

¶ Mycologia, i. (1909) pp. 77–9.

Diseases of the Vine.*—Ew. H. Rübsaamen has published a well-illustrated pamphlet to inform vine growers as to the diseases they may expect to find attacking their plants, due either to insects or fungi. Among the latter he describes *Peronospora viticola*, *Oidium Tuckeri* (with its fruiting form, *Uncinula necator*), *Glœosporium ampelophagum*, *Pseudopeziza tracheiphila*, *Sclerotinia Fuckeliana*, *Cercospora viticola*, and *Læstadia Bidwelli*, all of them microscopic fungi that attack leaves, fruits, or twigs. In addition, there are several root-fungi that also do great damage—such as *Rosellinia necatrix*, a minute form, and, among larger fungi, *Ithyphallus impudicus*, *Collybia platyphylla*, *Poria Vaillantii*, and some others of less importance. In each case the author describes the appearance of the fungus, and advises the grower how to check it, or, if possible, to eradicate it. The insect pests are also described in the same complete manner.

Plant Diseases.†—B. Issatschenko undertook a series of experiments to determine the conditions under which a fungus normally a saprophyte would develop into a parasite. He used spores of *Aspergillus niger* on a series of plants, and found that a moist atmosphere obtained by using a bell-jar, leaves sprinkled with sugar, or leaves covered with honey-dew, were the conditions that enabled the fungus to seize on the living plant. Etiolated seedlings of *Zea* were infected, while those non-etiolated remained sound.

Th. Wulff ‡ writes a popular account of fungi noxious to birchwood. *Polyporus betulinus* kills the trees from the top, and the mycelium lives in the tree some years before the fruiting form is produced. It turns the wood white, while *P. fomentarius* turns it red.

F. C. von Faber § gives an account of fungoid diseases of coffee on leaves, fruits, and stems. He describes the fungi in great detail, giving the life-history as far as possible, and advises as to the methods of dealing with them. *Stilbella flavida* and *Mycosphærella coffieicola* attack the leaves, while branches and stems are diseased by *Rostrella Coffeæ*, causing canker, and *Corticium javanicum*, which kills the branches, covering them with its felt of mycelium. *Hendersonia Coffeæ*, *Hemileia vastatrix*, a species of *Nectria*, etc., are also noted as causing damage to coffee plants.

H. Quanger ‖ gives some additional information as to the occurrence of *Corynespora Mazei* in Holland. The disease is confined to the leaves of cucumber, and does not attack the fruit.

P. Magnus ¶ describes a new species of *Ramularia* on the leaves of *Polygala vulgaris*, and discovered in South Tyrol by A. Heimerl. The conidiophores emerge from the leaf through the stomata. *Ramularia* and similar parasitic fungi occur frequently in the Tyrol, where alternat-

* Deutsches Verlagshaus. Berlin: Bong and Co. (1909) vii. and 126 pp. (3 col. pls. and 41 figs.).

† Bolezni rostenji (Jahrb. Pflanzenkr.) St. Petersbourg, ii. (1908) pp. 9–12. See also Bot. Centralbl., cxi. (1909) p. 108.

‡ Skogvardsf. Tidskr., i. (1909) pp. 1–14. See also Bot. Centralbl., cxi. (1909) p. 110.

§ Centralbl. Bakt., xxiii. (1909) pp. 193–210 (3 figs.).

‖ Tydschrift voor Plantenziekten, 1908, p. 78 (1 fig.). See also Zeitschr. Pflanzenkr., xix. (1909) pp. 304–5.

¶ Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 214–22 (5 figs.).

ing hot and moist conditions favour their development. Magnus gives a list of those that have been found in that region.

Arthur S. Horne * has been studying a potato disease known as "Internal Disease." He finds that it is due to an organism in the host-cell, a small vesicle attached to the wall of the cell. The vesicle increases in size and gives rise to one or more spheres which bud off sporangia; finally, spores are formed, which give rise to exceedingly small swarm-spores. Horne suggests that it be regarded as a Chytridiaceous fungus of generic rank, standing near the Olpidiaceæ and Synchytriaceæ.

A tomato disease † new to England is caused by the fungus *Septoria Lycopersici* var. *europæa*. The leaves of the plant are attacked first and rapidly killed, then stem and fruit. A crop of outdoor tomatoes was destroyed by it in Gloucestershire in 1907, and it reappeared in 1908. Instructions are given for dealing with the disease.

L. Petri ‡ describes the drying up of olive leaves due to the presence of the parasitic fungus *Phyllosticta insulana*. It destroys the leaves, and is capable of causing very great loss. Petri notes the points of difference between this and other parasites of olive-leaves.

A disease § termed apple blotch has been doing great harm in the orchards of the southern United States. W. M. Scott and James B. Rorer have made a study of the fungus, *Phyllosticta solitaria*, that causes the disease. It may occur on leaves, branches, or fruits: on the latter it causes cracks and splits, and seriously lessens the value of the apples; the fungus seems to persist on the branches. Spraying with Bordeaux mixture is recommended.

The Board of Agriculture ‖ takes note of the disease of gooseberry bushes caused by *Puccinia Pringsheimiana*—it has been apparently more prevalent this year than usual. Two cases of disease due to coral spot (*Nectria cinnabarina*) are reported; apricot stems and gooseberry bushes were both fatally injured. Potatoes from Montrose were attacked by *Rhizoctonia violacea*; others from Manchester were injured by dry-scab, *Spondylocladium atrovirens*.

Em. Marchal ¶ examined the deformed fruits of a pear, and found that they had been attacked by *Phytophthora omnivora*; the fallen fruits were found to be filled with the oospores of the fungus. These fruits should be carefully destroyed, and the trees sprayed with Bordeaux mixture.

E. Pâque ** gives a sketch of the history of the oak mildew in Europe. He describes the appearance of the fungus, and discusses at some length its systematic position. He is certain that the species is indigenous, that the recent outbreak is due to special atmospheric conditions, and that there is no need to be alarmed about the spread of the disease.

* Ann. Mycol., vii. (1909) pp. 286–8.
† Board of Agric. Leaflet 225 (1909) 3 pp. (5 figs.).
‡ Atti Reale Accad. Lincei, cccvi. (1909) pp. 620–3 (2 figs.).
§ U.S. Dep. Agric. Bureau Pl. Ind., Bull. No. 144 (1909) 23 pp. (6 pls.). See also Ann. Mycol., vii. (1909) pp. 308–9.
‖ Journ. Board. Agric., xvi. (1909) p. 297.
¶ Bull. Soc. Roy. Bot. Belg., xlv. (1908) pp. 343–4.
** Tom. cit., pp. 344–54.

The yearly record of plant diseases * has just been issued by M. Hollrung. He sums up in his journal all that has been published on plant pathology in different countries during the year 1907. A large part of the work deals with fungal parasites, and these are described by him and the original references given. Chapters on hygiene and therapeutics add to the completeness of the work. Bibliographies are added after each chapter, and a full index renders the whole easy of reference.

J. F. Chittenden † finds that *Coleosporium Senecionis* causes a disease of *Cinerarias*; the uredo stage appears in September. Scorching of apple leaves is due to *Cladosporium herbarum*. Bad cultivation and unfavourable weather render the foliage more liable to attack. Spraying with Bordeaux mixture keeps the fungus in check.

Mycorhiza Problems.‡—Jaroslav Peklo has made cultures of the fungi forming the mycorhiza of *Carpinus* and *Fagus*. Carefully prepared material and microtome sections enabled him to see the character of the hyphæ. In *Carpinus* they are somewhat swollen, and push themselves between the cells of the host. In *Fagus* he found a hyphal layer rich in material resembling tannin; outside that was another layer full of what seemed to be glycogen.

The isolation and cultivation of the fungi presented peculiar difficulties, but these were overcome, and Peklo has identified the fungus of *Carpinus* roots with a *Penicillium* very similar to *P. geophilum* Oudem. The mycorhiza of *Fagus*, he found, was also formed by *Penicillium*. The swellings on the roots of *Alnus* were also studied and reproduced by infection cultures. Peklo considers that the organism causing these is akin to *Streptothrix*, and compares it with *Actinomyces*.

BANKER, HOWARD J.—**A New Fungus of the Swamp Cedar.**
[The parasite is one of the Hydnaceæ, *Steccherinum Ballonii* sp. n.]
Bull. Torrey Bot. Club, xxxvi. (1909) pp. 341-3 (1 pl.).

BULLER, A. H. R.—**The Destruction of Wood by Fungi.**
[An account of what is known on this subject, and of the methods employed for preserving timber from fungoid attacks.]
Sc. Progr., 1909, pp. 361-78.

CRUCHET, PAUL—**Contribution à l'Étude de la Flore cryptogamique du Canton du Tessin.**
[List of parasitic fungi.]
Bull. Soc. Vaud. Sci. Nat., xlv. (1909) pp. 329-39.

DIETEL, PAUL—**Uredinaceæ paræenses.**
[A number of new species are described.]
Bol. Mus. Goeldi, v. (1909) pp. 262-7.

FERDINANDSEN, C., & O. WINGE—**Phycomycetæ, Ustilagineæ, Uredineæ, Discomycetæ, Pyrenomycetæ, et Fungi Imperfecti.**
[The authors add 75 species to the fungi already known from the Danish West Indies; 19 are new to science.]
Dansk. Bot. Tidssk., xxix. (1908) pp. 1-5.
See also *Bot. Centralbl.*, cx. (1909) pp. 659-60.

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* Jahrb. Pflanz.-Krankh., x. (1907). Berlin: Paul Parey (1909) x. and 402 pp.
† Journ. Roy. Hort. Soc., xxxiii. (1908) pp. 500-13.
‡ Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 239-47.

FERRARIS, TEODORO—**Osservazioni micologiche su specie del gruppo Hyphales (Hyphomycetæ).** (Mycological observations on species of Hyphomycetes.]
[Notes on various genera—*Stilbum, Isaria, Isariopsis, Stysanus*, etc.]
Ann. Mycol., vii. (1909) pp. 273–86 (2 figs.).

GUÉGUEN, FERNAND—**Formes evolutives et caractères spécifiques de l'Aspergillus Fontoynonti.** (Evolution forms and specific characters of *Aspergillus Fontoynonti.*)
[Description and diagnosis of a new species.]
C.R. Soc. Biol. Paris, lxvii. (1909) pp. 10–12.

HENNINGS, P.—**Exogone kaiseriana g. et sp. n.**
[The fungus found on cabbage-stalks and pine-needles is near to *Rhizina*, an Ascomycete.]
Abh. Bot. Ver. Prov. Brandenb., l. (1908) pp. 129–31 (5 figs.).
See also *Ann. Mycol.*, vii. (1909) p. 301.

HÖHNEL—**Mykologisches. XXII. Zur Alpinen Macromyceten-flora.**
[The larger fungi of the Alps.]
Oesterr. Bot. Zeitschr., lix. (1909) pp. 62 and 108.
See also *Bot. Centralbl.*, cxi. (1909) p. 103.

KEISSLER, KARL VON—**Neue Pilze von den Samoa- und Salomoninseln.** (New fungi from the Samoa and Solomon Islands.)
[Most of the species described are parasitic microfungi.]
Ann. Mycol., vii. (1909) pp. 290–3.

KNOLL, F.—**Eine neue Art der Gattung Coprinus.** (A new species of *Coprinus*.)
[The new species resembles *C. pseudoplicatilis*, but differs in the absence of cystidia.] *Oesterr. Bot. Zeitschr.*, lix. (1909) pp. 129–33 (2 figs.).
See also *Ann. Mycol.*, vii. (1909) p. 331.

KUFFERATH, H.—**Sur l'Agglutination de la Levure.** (The agglutination of yeast.)
[Agglutination was brought about by the use of chemical reagents, chiefly sodium chloride.] *Bull. Soc. Roy. Belg.*, xlv. (1908) pp. 392–403.

MAIRE, RENÉ—**Contribution à l'Étude de la Flore mycologique des Pyrénées.** (Contribution to the study of the mycological flora of the Pyrenees.)
[Fungi collected at a meeting of the Botanical Society at Gavarnie and Cauterets in 1907. There is one new genus in the list, *Volkartia*, near to *Taphrina*. *Bull. Soc. Bot. France*, vii. (1907) pp. cxliv–clxv (1 fig.).

MASSALONGO, C.—**Osservazione fitologiche.** (Observations on galls and monstrosities produced by fungi.)
Madonna Verona, ii. I. (Verona, 1908) p. 12 (12 figs.).
See also *Bot. Centralbl.*, cxi. (1909) p. 5.

MIGULA, W.—**Kryptogamen-flora.**
[Continuation of the Chytridineæ—Peronosporineæ.]
Flora von Deutschland, lief. 73–5 (1909) pp. 129–76 (15 pls.).

MÖBIUS, M.—**Kryptogamen.**
[A popular presentation of cryptogamic botany, with chapters devoted to fungi, mycetozoa, and lichens.]
Leipzig: Quelle and Meyer (1908) 146 pp.
See also *Bot. Centralbl.*, cxi. (1909) p. 83.

MURRILL, W. A.—**Illustrations of Fungi. II. and III.**
[Several well known species are described and illustrated, with plates of coloured figures on a dark ground.]
Mycologia, i. (1909) pp. 37–40 and 83–6.

„ „ **The Boletaceæ of North America. II.**
[One genus only is dealt with, *Ceriomyces* Battar.]
Mycologia, i. (1909) pp. 140–60.

„ „ **Polyporaceæ from Japan.**
[A number of new species are included.]
Tom. cit., pp. 164–70.

PECK, C. H.—**New Species of Fungi.**
[Mostly the larger fungi; a few species of microfungi are also included.]
Bull. Torrey Bot. Club, xxxvi. (1909) pp. 329–39.

PETCH, T.—**The Genus Chitoniella.**
[The author places in this genus *Psalliota poderes*, with green spores.]
Ann. R. Bot. Gard. Peradeniya, iv. (1908) pp. 113–22 (3 pls.).
See also *Ann. Mycol.*, vii. (1909) p. 302.

,, ,, **The Phalloideæ of Ceylon.**
[An account of all the species found in Ceylon.]
Tom. cit., pp. 139–84 (11 pls.)
See also *Ann. Mycol.*, vii. (1909) pp. 302–3.

RACIBORSKI, M. — **Nalistne i pasorzytne grzyby Jawy.** (Parasitic and epiphytic fungi from Java.)
[A great nunber of new fungi are described; the new genera are: *Farysia* (Ustilagineæ), *Ordonia* (Uredineæ), *Alina* and *Paidania* (Pyrenomycetes).
Bull. Int. Acad. Sci. Cracovie, No. 3 (1909) pp. 346–94 (6 figs.).

REA, CARLETON—**Botany of Worcestershire.**
[List of fungi found in the county.]
Birmingham: Cornish Brothers, 1909, pp. 502–638.

ROUPPERT, CASIMIR—**Rewizya rodzaju Sphærosoma** (Revision of the genus *Sphærozoma.*)
[Two subgenera—*Tulasnia*, with brown spores, and *Eusphærozoma*—are recognised by the author.]
Bull. Int. Acad. Sci. Cracovie, 1909, pp. 75–95 (2 pls. and 6 figs.).

SEAVER, F. J.—**The Hypocreales of North America. I.**
[The Nectrieæ, including eleven genera, are described.]
Mycologia, i. (1909) pp. 41–76 (2 pls.).

,, ,, **Discomycetes of North Dakota.**
[A list of species belonging to 34 genera, found mostly by the writer.] *Tom. cit.*, pp. 104–14.

TIRABOSCHI, C.—**Attenuazione del potere germinativo delle spore di Penicillium glaucum mantenuto a 37° C.** (Attenuation of the germinative power of the spores of *Penicillium glaucum* maintained at 37° C.)
[After a month, the germinating power was completely destroyed.]
Rivista pellagrologica, viii. (1908) 16 pp.
See also *Bot. Centralbl.*, cxi. pp. 37–8.

VAN BAMBEKE, CH.—**Sur Polystictus cinnamomeus Sacc. et P. montagnei Fr.**
[A discussion as to the autonomy of these two fungi, and as to whether they may not both be forms of *P. perennis*.]
Bull. Soc. Roy. Belg., xlvi. (1909) pp. 1–24 (1 pl.).
See also *Ann. Mycol.*, vii. (1909) p. 305.

VLEUGEL, J.—**Bidrag tell Kannedomen om Umeatraktens svampflora.** (Contribution to the fungus flora of the Umea district.)
[List of species, with notes and added diagrams; several new species are described.]
Svensk. Bot. Tidssk., ii. (1908) pp. 304–24, 364–89.
See also *Ann. Mycol.*, vii. (1909) p. 305.

,, ,, **Zur Kenntnis der auf der Gattung Rubus vorkommenden Phragmidium Arten.** (The *Phragmidia* of *Rubus.*)
Tom. cit., pp. 123–38.
See also *Bot. Centralbl.*, cxi. (1909) p. 105.

WILSON, GUY WEST, & F. J. SEAVER — **Ascomycetes and Lower Fungi. Fasc. ii.**
[A list of 25 fungi contained in the fascicle, with various notes.]
Mycologia, i. (1909) pp. 121–5.

Lichens.

(By A. Lorrain Smith.)

Physma dalmaticum.*—A. Zahlbruckner described some peculiar bodies in the thallus of this lichen, and Em. Senft has made a thorough examination of the tissues to determine their character and nature. They are at first globose or ovate in form, becoming irregular later, and lie usually free in the mucilage. They are not unlike cystoliths in appearance. After prolonged testing and examining of their properties, he finds that they are the products of enzymatic action on the hyphæ of the lichen.

The Genus Usnea.†—R. Heber Howe has issued preliminary notes of a proposed monograph of this genus of Lichens. Under the comprehensive name of *Usnea barbata* he recognises four distinct species, *U. florida*, *U. ceratina*, *U. dasypoga*, and *U. plicata*; all of these being more or less papillate, but differing in modes of branching, occurrence of fruits, and general size of the plants. *U. florida* is the species that bears most abundant fruit, especially in swampy regions with abundant moisture; in drier regions only a few plants bear apothecia. Among the epapillate species, the commonest in the States is *U. trichodea*, a slender filamentous plant. *U. longissima* is common in high altitudes, and attains a length of nearly 4 m. A list is given of New England records of species of *Usnea*.

Studies in Peltigera.‡—Georg Bitter publishes a morphological account of *Peltigera nigripunctata* sp. n., and of the cephalodia which occur on the surface, to which it owes its name. It was included by Hue under *P. horizontalis*. The alga forming the thallus is a small yellowish-green *Stichococcus*; the alga of the cephalodia is a deep blue-green *Nostoc*. Bitter considers that the species stands midway between *Peltigera horizontalis* and *P. venosa*, the latter also a species with cephalodia. The appearance of the thallus in each lichen is described and compared.

Cyphelium (Acolium) verrucosum sp. n.§—This new lichen was found growing in great abundance on old worked wood in Schleswig-Holstein, and has been described by F. Ericksen. In the near neighbourhood, *Cyphelium inquinans* was also found to be very plentiful: it differs in the form and size of the spores, and in the potash reaction of the thallus.

Collection of Lichens.‖—Bouly de Lesdain sums up his work on the lichens of Versailles by giving a list of those found on various debris in the Park, such as broken glass, old iron, leather, cloths, paper, silver, felt, etc. He records not only lichens, but mosses and fungi from

* S.B. Akad. Wiss. Math.-Nat. Kl., cxvi. (1907) pp. 429-38 (1 pl.).
† Bull. Torrey Bot. Club, xxxvi. (1909) pp. 309-26 (3 pls.).
‡ Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 186-95 (1 pl.).
§ Hedwigia, xlviii. (1909) pp. 210-11.
‖ Bull. Soc. Bot. France, ix. (1909) pp. 3-7.

these strange substrata. His list for Versailles includes 267 lichens and 15 parasitic fungi.

Harmand* publishes a further account of the lichens of Portugal. He follows generally the order adopted by Mylander, and gives the locality and habitat for each species. Two new species of *Verrucaria* are published. A short list of microscopic fungi is added, with one new species of *Trematosphæria*.

Composition of a Desert Lichen-flora.† — Bruce Fink bases his ecological notes and observations on a series of lichens collected in the vicinity of the Carnegie Botanical Laboratory. He gives the list, thirty-three in all, most of which were growing on rocks. He gives a general consideration of structure in connection with the power of retaining moisture, and notes the protective coloration provided by dark dots and lines on otherwise light-coloured thalli. Attention was paid to the opportunities for obtaining water by the lichens, but no definite conclusions have been reached on this question; they have no special adaptation for storing water, nor have they organs extending any considerable distance into the soil whereby they could extract moisture.

Ecological Study of Lichens.‡ — O. Galloë gives first an account of the effect of water and light on lichens, then of the different places where they are to be found—downs, heaths, moors, woods, and stones. No lichens grow on sea-sand: a few begin to appear on the dunes, *Cornicularia aculeata* being the pioneer, followed by *Cladonia rangiferina* and *C. uncialis*. *Peltigera canina* frequents sandy soil. The author finds seventeen lichens grow on sand, many of them *Cladoniæ*. Few or none grow on wet moors, but they appear along with *Calluna*. Woods that are too shaded are also destitute of lichens, and none grow under the deep shade of pine-trees, but if these should by chance lose their needles the same lichens appear as grow on heaths. The oak supports the largest number of lichens, sixty-three species having been recorded on it; many are found also on *Fraxinus*, *Alnus*, *Betula*, and *Populus*. The author passes in review 138 species of lichens that live on rocks, and notes the conditions in which they are found.

AMPHLETT, J., & C. REA—**The Botany of Worcestershire.**
[List of lichens in the Herbarium, Worcester.]
Birmingham: Cornish Brothers, 1909, pp. 488–501.

KRONFELD, E. M.—**Scopoli und die Cetraria islandica.** (*Scopoli* and *Cetraria Islandica*: a contribution to medicinal botany in Austria.)
Wien Klin. Wochenschr., xxii. (1909) No. 2, 7 pp.
See also *Hedwigia*, Beibl., xlviii. (1909) p. 165.

LINDAU, G.—**Lichenes peruviani.**
[List of species from the Andes and the Province Cundinamarca. The lichens were collected by Wederbauer and Pehlke; four new species are described.] *Engl. Bot. Jahrb.*, xlii. (1908) pp. 49–60.
See also *Ann. Mycol.*, vii. (1909) p. 311.

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* Bull. Soc. Bot. France, ix. (1909) pp. 7–14, 27–34, 82–90, 125–31, and 213–19.
† Mycologia, i. (1909) pp. 87–103.
‡ Dansk. Bot. Tidssk., xxviii. (1901) pp. 285–372 (14 pls. and 200 figs.). See also Bot. Centralbl., cxi. (1909) pp. 65–7.

Lindau, G., & A. Zahlbruckner — **Lichenes von Madagascar, Mauritius, und dem Comoren.**
[Determined by Lindau, with descriptions of new species by A. Zahlbruckner.]
Voeltzkow, Reise Ostafrika, 1903–5, iii. (Stuttgart, 1908) 14 pp. (1 (pl).
See also *Hedwigia*, Beibl., xlviii. (1909) p. 166.

Pitard, J., & Bouly de Lesdain—**Lichens récoltés pendant la Session de la Société botanique de France à Gavarnie.** (Lichens collected during the meeting of the Botanical Society at Gavarnie.)
[Notes are given as to locality and altitude.]
Bull. Soc. Bot. France, vii. (1907) pp. cxlv–viii.

Rave, P.—**Untersuchung einiger Flechten aus der Gattung Pseudevernia im bezug auf ihre Stoffwechselprodukte.** (Research on *Pseudevernia* species in connection with vegetable products.)
Inaug. Diss., Boma. Leipzig: R. Noske (1908) 51 pp. (2 pls.).
See also *Ann. Mycol.*, vii. (1909) p. 311.

Schiffner, Viktor—**Die Mitzpflanzen unter den Flechten.** (Useful plants among lichens.)
[An account of those used for food, medicine, and in the arts.]
Naturwiss. Wochenschr., viii. (1909) No. 5, pp. 65–72 (figs.).
See also *Hedwigia*, Beibl., xlviii. (1909) p. 166.

Wilson, A., & J. A. Wheldon—**Cladonia luteoalba sp. n.**
[Distinguished by the sulphurous under-surface of the thallus and the scarlet apothecia.] *Trans. Liverpool Bot. Soc.*, i. (1909) p. 7.
See also *Journ. Bot.*, xlviii. (1909) p. 324.

Zahlbruckner, A.—**Materialen zu einer Flechtenflora Braziliens.** (Materials for a lichen flora of Brazil.)
[The list includes one new species.]
Bol. Mus. Goeldi, v. (1909) pp. 258–61.

Zopf, W.—**Zur Kenntnis der Flechtenstoffe.** (Knowledge of lichen products.)
[The genera *Peltigera*, *Nephroma*, and *Solorina* were examined, and new products were discovered.]
Liebig's Ann. Chemie, ccclxiv. (1909) pp. 273–313.
See also *Ann. Mycol.*, vii. (1909) p. 312.

Mycetozoa.

(By A. Lorrain Smith.)

Plasmodiophoraceæ and Phytomyxineæ.*—René Maire and Adrien Tison have made a study of *Sorosphæra Veronicæ*, *Plasmodiophora Brassicæ*, and of a series of organisms included in the Phytomyxineæ; the latter class, they conclude, is a heterogeneous group, and the name ought to disappear. They find that *Sorosphæra Veronicæ* is not a filamentous fungus, but a *Plasmodiophora*; they compare its development with that of *P. Brassicæ*, and find in both a schizogonic and a sporogonic phase, in which the nuclear divisions present characteristic differences, which are carefully followed and figured. Spores are formed without any conjugation. Finally, they conclude that the Plasmodiophoraceæ are a distinct group between the Sporozoaires and the Myxomycetes. The authors give notes on the other organisms formerly classified as Phytomyxineæ.

* Ann. Mycol., vii. (1909) pp. 226–53 (3 pls.).

New Plasmodiophora.*—M. Molliard found specimens of *Triglochin palustre* affected with galls on their stalks, of a white colour, somewhat resembling the tumours produced by *Cystopus candidus*. Examination proved the organisms causing the gall to be a species of Plasmodiophoreæ, belonging to the genus *Tetramyxa*. The host-plants grew in marshy soil, and infection from the zoospores evidently took place when the stalks were quite young. Stalks and flower were much deformed by the action of the parasite.

Insect Parasite.†—Louis Leger describes a "mycetozoaire," *Peltomyces hyalinus* g. et sp. n., which he found in the Malpighian tubes of beetles. He describes the vegetative condition—first a small globose nucleated mass, which increases, giving rise to a plasmodium followed by the spore-forming stage, in which he traces distinct sexuality—the formation and subsequent fusion of different kinds of nuclei. The ripe spores are evacuated from the body of the insect with the excreta. The author places the genus near to *Plasmodiophora*.

REA, CARLETON—**Botany of Worcestershire.**
[List of Mycetozoa found in the county.]
Birmingham: Cornish Brothers, 1909, p. 626–30.

JACZEWSKI, A. A.—**Mykologische Flora des europäischen und asiatischen Russlands II. Myxomycetæ.** (Mycological flora of European and Asiatic Russia. II. Myxomycetes.)
Materialen zur Kenntn. Faun. u. Fl. Russ. Reiches, Bot. Teil., fasc. vi. (Moscow, 1907) pp. 1–140 (84 figs.).
See also *Bot. Centralbl.*, cxi. (1909) pp. 105–6.

Schizophyta.

Schizomycetes.

Garget in Cows.‡—W. G. Savage finds that mastitis or garget in cows is due either to Streptococcus, Staphylococcus, or *Bacillus coli*, but chiefly to a streptococcus of a definite type—spoken of as *Streptococcus mastidis*. The characters of this type are long twisted chains staining by Gram's method, producing acid in milk and clot within three days at 37° C.; acid is produced in lactose and in saccharose media, but never in mannite, and not usually in salicin, raffinose, or inulin; they are non-pathogenic for mice on subcutaneous injection; they grow rapidly but readily die out in ordinary broth. Infection probably arises by an upward invasion of the udder through the teats.

Bacteria of Sewer Air.§—F. W. Andrewes, by exposing plates of McConkey's bile salt lactose neutral red agar media to the air of sewers, found that sewage bacteria may be readily demonstrated, especially in manholes over main drains, and that the determining cause of the presence of sewage bacteria in the drain air is droplet contamination from splashing. The number of sewage bacteria in drain air is influenced by the volume of the sewage flow. The number of lactose

* Bull. Soc. Bot. France, ix. (1909) pp. 23–5.
† Comptes Rendus, cxlix. (1909) pp. 239–41.
‡ Rep. Local Govt. Board, 1907–8, p. 359. § Tom. cit., p. 266.

fermenting coliform bacilli in the drain air bears a direct relation to the abundance of fæcal material in the sewage.

Protective Agents in Meningococcus Infection.*—T. J. Horder and M. H. Gordon have found that there is no evidence of any protective influence exerted by immune sera when lethal doses of the meningococcus were injected into rabbits; but by employing meningococcus vaccination a considerable protection against infection by the same organism was obtained.

Gaertner Group of Organisms.†—W. G. Savage shows from his observations that it is convenient to recognise a more exclusive enteritidis group (type organism *B. enteritidis* Gaertner) as a sub-group of the larger group containing organisms of the Gaertner type. Members of the Gaertner group with the characters of the recognised pathological members of this group are not found in the healthy animal intestines of the ordinary domestic animals used for food; organisms which superficially resemble bacilli of the Gaertner group, both *B. paratyphosus* (*b*) and (*a*), are met with in small numbers; there is no evidence that these Gaertner simulating organisms found in the healthy intestine, are of any pathological significance; by extended cultural investigation they can be differentiated from the true meat poisoning bacilli.

Indirect Denitrifying Bacteria.‡—L. Grimbert and M. Bagros have designated as "indirect denitrifying bacteria" organisms of which *B. coli* and *B. typhosus* are types, and which attack nitrates only through the intervention of amines or amide substances; they cause firstly a reduction of nitrate to nitrite, which then reacts on the amide substance of the medium in which the organism is growing, setting free N and CO_2. The authors express this by the equation—

$$CO\,(Az\,H_2)_2 + 2\,Az\,O_2H = 4\,Az + CO_2 + 3\,H_2O.$$

Bacteria Intermediate between Bacillus paratyphosus B and Bacillus typhosus.§—J. Babes and Feodorasco have isolated from the organs of a patient who died with symptoms of typhoid, two different bacilli which were biologically intermediate between *Bacillus paratyphosus B* and *B. typhosus*. Bacillus (1) differed from *B. paratyphosus* in having no action on neutral red, not producing alkalinity in milk, and not agglutinating with paratyphoid serum. It differs from *B. typhosus* by the production of gas and late alkalinity in Petruschki's medium, in producing a green colour on artichoke, and in not agglutinating with typhoid serum. Bacillus (2) resembles *B. paratyphosus*, but it produces alkalinity in milk from the commencement; it produces no green colour on artichoke, and is not agglutinated by paratyphoid serum. Two other bacilli resembling *B. coli* were also isolated.

Effect of Radium on Bacteria.‖—C. E. Iredell and E. P. Minett exposed cultures of *Bacillus pyocyaneus*, *B. anthracis*, *B. subtilis*, *Staphylococcus aureus*, *B. megatherium*, *B. coli communis*, *B. typhosus*,

* Rep. Local Govt. Board, 1907–8, p. 341. † Tom. cit., p. 425.
‡ C.R. Soc. Biol., Paris, lxvi. (1909) p. 760. § Tom. cit., p. 787.
‖ Lancet, May 22 (1909) p. 1445.

to the action of radium for periods varying from 10 to 60 minutes. In every case the authors found there was no alteration in the capacity for growth, staining reaction, colour production, or motility. It was, however, noted that there was a slight increase in motility of *B. typhosus* after 15 minutes' exposure, but not so after 30 to 60 minutes' exposure.

Bacteria in the Air.*—K. Saito exposed Petri plates with various nutrient media, for one minute to the air in different situations, and at different times of day, and made observations of the number and variety of bacterial colonies that grew. The author found that in the air of the botanical gardens, the average maximum number of colonies appeared in November, the average minimum in September; the air of various streets gave a fewer number than the garden air; generally, organisms were found to be more numerous in warm and dry than in cold and moist seasons; the numbers are increased by wind; after rain and snow the air holds very few bacteria. In the course of his research the author isolated 55 varieties of bacilli and 17 varieties of cocci, of which one, *Sarcina agilis*, was a new species.

Biological Study of Glanders Bacilli.†—W. Stickdorn finds that the virulence of glanders bacilli is lowered by prolonged cultivation on nutrient media; after passing through white mice the virulence for white mice is maintained, but it is lowered for grey mice; passage through pigeons assists the virulence for pigeons, but raises the virulence for grey mice.

Cultural Differences of two Pseudo-tubercle Bacilli.‡—L. Vincenzi contrasts the *Bacillo opale agliaceo*, a pseudo-tubercle bacillus having a blue coloured growth on gelatin, and a strong odour of garlic, with a bacillus of Pfeiffer. Both organisms are non-motile, round-ended rods with capsules, arranged in chains, not producing spores, and being potential anaerobes; they both grow on all ordinary media, but *B. opale agliaceo* grows at 0° C., whereas the minimum temperature for Pfeiffer's bacillus is 5° C. The growths on gelatin are similar, but that of *B. opale* is paler and has a blue tint; that of Pfeiffer's bacillus is pale yellow, and has a mottled appearance; colonies of *B. opale* are moist and shining, those of Pfeiffer's bacillus are dry; in gelatin streak cultures the growth of *B. opale* is thin, opalescent, and moist; that of Pfeiffer's bacillus is thick, whitish-yellow, and dry; both organisms are pathogenic for guinea-pigs and rabbits, but *B. opale* has a higher degree of virulence.

Chromogenic Bacillus isolated from a Mineral Water.§—L. Gaucher isolated from Vals water an actively motile, pigment-forming bacillus. It is about 7–8 μ long and 1 μ broad; it is easily stained, but is Gram-negative. Its optimum temperature is 20° C.; it it a potential anaerobe, but does not form pigment without access of air; it forms acid, and liquefies gelatin slightly. The colonies attained

* Journ. Coll. Sci. Imp. Univ. Tokyo, xxiii, art. 15.
† Centralbl. Bakt., 1te Abt. Orig. l. (1909) p. 5.
‡ Tom. cit., p. 2.
§ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 745–6.

their maximum hue (red) in 7 days, after which the colour faded away. The first sub-cultures were pale red, but the third and fourth generations were quite white.

Spore Formation in the Disporic Bacteria.*—C. C. Dobell, in an article on the so-called "sexual" method of spore formation with disporic bacteria, contests the views of Schaudinn, formed as the result of the latter's observations on *Bacillus bütschlii*. These views, possibly promoted by Schaudinn's belief in the diphasic nature of protoplasm, were to the effect that the peculiar event immediately preceding sporulation should be interpreted as representing a primitive or degenerate method of conjugation. The author made observations on two bacteria, one *B. spirogyra* already described, and a new species *Bacterium lunula*. This latter has an average length of 11μ, is curved, and, like *B. spirogyra*, possesses a chromatic filament with nuclear properties. The author's researches lead him to corroborate Schaudinn's facts, but he interprets them in a different way, and instead of seeing a degenerate sexual process he regards the phenomena as merely expressing an abortive cell division.

Anaerobic Vibrios from the Mouth.†—G. Repaci describes three vibrios, two of which are motile, the third motionless. All three are essential anaerobes, stain well, but are Gram-negative. They do not form spores, and in old cultures at 37° C. do not present involution forms. They are easily distinguished by the manner and character of the growths on artificial media.

The positive characters of Vibrio A ($2–3\mu \times 1 \cdot 2\mu$), are that the primary culture on agar does not appear for 4 or 5 days, while sub-cultures are visible in 24 hours. The colonies are target-like, i.e. show a series of concentric rings. It ferments glucose and lactose. It kills guinea-pigs in about six days.

Vibrio B ($4–5\mu$ long), attains its maximum growth in 24 hours. It ferments glucose, lactose, and saccharose, and acidifies milk. It is non-pathogenic.

Vibrio C (8μ long), attains its maximum development on agar in about two days, the colonies looking like little balls. It attacks glucose, lactose, and dextrose. It acidifies milk. The cultures exhale an odour of rotten cheese. At incubation and room temperature they live quite a long time, and successive sub-culturing does not exhaust their vitality. This vibrio is non-pathogenic.

Bacillus of Septicæmic Cerebro-spinal Meningitis.‡ — Cohen describes a bacterium which he has discovered in cases of meningitis. It is a small, thin bacillus ; Gram-negative ; stains feebly with toluidin-blue, but more deeply with Ziehl-Nielsen and with Giemsa ; occurs often in pairs and in short chains ; is usually extra-cellular. It is non-motile, is essentially aerobic, with an optimum temperature of 37° C. Its viability is limited to about 3 weeks, and it is easily

* Quart. Journ. Micr. Sci., liii. (1909) pp. 579–96 (1 pl. and 3 text figs.).
† C.R. Soc. Biol. Paris, lxvi. (1909) pp. 630–2.
‡ Ann. Inst. Pasteur, xxiii. (1909) pp. 273–311.

destroyed by desiccation. It grows well only on blood media such as blood agar and blood broth. After a few days' growth involution forms are abundant. Inoculated on animals it produces a fatal septicæmia, but it is possible to vaccinate the animals against this result by the injection of gradually increasing doses of the bacillus, and the serum of the immunised animals possesses a markedly curative action, even after the injection of a fatal dose.

In most of its characters, morphological and physiological, it has a striking resemblance to the influenza bacillus, but the serum of animals immunised against the bacillus of Pfeiffer has neither a curative nor a preventive action.

Endotoxin of Bacillus Diphtheriæ.*—L. Cruveilhier finds Loeffler's diphtheria bacillus is possessed of an endotoxin which is quite distinct from the soluble toxin. A very small dose kills guinea-pigs within 24 hours. The method of obtaining the endotoxin was to make an emulsion of a 24-hours' old agar culture, and then heat the emulsion in an autoclave at a temperature of 100°–105° C. for 15 to 20 minutes in order to remove any trace of the soluble toxin. When cold the solution was filtered.

Flügge's Fluorescing Bacilli.†—The general characters of the two fluorescing bacilli of Flügge, *B. fluorescens liquefaciens* and *putridus*, says E. Griffon, are as follows:—They do not form spores, are Gram-negative, the cultures exhale a fæcal odour, have an alkaline reaction, and in many media there is a beautiful green fluorescence. One liquefies gelatin, the other does not. Owing to this last property, to differences in the amount of the green pigment, the rate of growth, the scum on broth, the amountof the deposit, the pathogenicity to animals, especially rabbits, some bacteriologists were led to make several varieties of these bacteria and even to distinguish certain new species, such as *B. caulivorus*, *brassicævorus*, *æruginosus*, etc. The author deprecates this multiplication of species, and holds that these fluorescing bacteria, so pathogenic to certain plants, are only varieties of *B. fluorescens* and *putridus*. The author seems inclined to make one species only, *B. fluorescens*. He points out that it is a saprophyte, which adapts itself very readily to parasitism, and the differences in its biological characters are due to the reaction and composition of the soil or medium, to the temperature and humidity of the atmosphere, and to the greater or lesser resistance of the plant attacked.

Determination of the Bovine or Human Origin of Tuberculosis.‡ A. Calmette and C. Guérin are of opinion that human and bovine tubercle may be differentiated by the two following criteria. Bovine tubercle may be cultivated with facility on ox-bile; when injected into the udder of goats, bovine tubercle causes a severe mammitis followed by the death of the animal, while human tubercle produces only a mild inflammation.

* C.R. Soc. Biol. Paris, lxvi. (1909) pp. 1029–30.
† Comptes Rendus, cxlix. (1909) pp. 50–3.
‡ Tom. cit., pp. 191–4.

Effects of Salts on Bacillus subtilis.* — C. B. Lipman, after an examination of the toxic and antagonistic effects of salts as related to ammonification by *Bacillus subtilis*, summarises his results as follows:— (1) Each of the four chlorides ($CaCl_2$, $MgCl_2$, KCl, NaCl) is toxic for *B. subtilis* in the order given, the first being the most toxic and the fourth the least. This is quite different from the results with higher plants, where magnesium is the most toxic and calcium the least. 2. A marked antagonism exists between Ca and K, Mg and Na, K and Na. 3. No antagonism exists between Mg and Ca, but the toxic effect of each is increased by the addition of the other to it. This is just the opposite of what has hitherto been found for plants.

Presence of Anthrax in the Intestinal Contents of Animals.† A. Cinca and G. Fenea examined the fæces of guinea-pigs, rabbits, sheep, and pigs affected with anthrax, and almost invariably found that the bacilli were present, and in numbers inversely proportional to the rapidity of the disease. Apparently the intestine favours spore-formation, so that anthrax cultures can be obtained by heating the fæcal matter to 65°; under these conditions the colonies are more numerous the later the examination is made. Hence a bacteriological examination of the fæces of animals affords a certain method for deciding if an animal has died of anthrax.

Eisenberg, P.—**Weitere Untersuchungen über Fetteinschlüsse bei Bakterien.** *Centralbl. Bakt.*, 1te Abt. Orig., li. (1909) pp. 115–21. See also this Journal, *ante*, p. 261.

Gougerot & Blanchetière —**Endotoxines sporotrichosiques. Action pathogène des corps microbiens tués et des corps résiduels.** *C.R. Soc. Biol. Paris*, lxvii. (1909) pp. 247–8.

Nicolle, C., & E. Conseil—**Fièvre mediterranéenne chez le cobaye par inoculation sous-cutanée et ingestion de cultures.** *Tom. cit.*, pp. 267–9.

* Bot. Gaz., xlviii. (1909) pp. 105–25 (5 figs.).
† C.R. Soc. Biol. Paris, lxvii. (1909) pp. 301–2.

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

Old Microscope by George Adams.—This Microscope was presented by Members of the Council to the Society's collection, and was exhibited at the Meeting on June 16.

The instrument, which is in excellent condition, almost as good as new, has the following inscription engraved on it:—"Invented & Made by Geo. Adams at Tycho Brahe's Head in Fleet Street, London." It is a combination of his "New Universal Single" and "New Universal Double" Microscopes, described and figured in his "Micrographia Illustrata," published in 1746. †

It is not easy to assign a date to the instrument in the absence of any description or reference, but as the same descriptions and figures just referred to appear in the 4th edition of "Micrographia Illustrata" published in 1771, it may fairly be concluded that the instrument now described may be of a somewhat later date.

Fig. 96 represents the instrument arranged as a Double Microscope, and it is to a scale of about one-half the actual size. It has a folding tripod base, from which rises an octagonal pillar bored out to receive a cylindrical stem that slides telescopically within it. The stem carries an eight-lobed disk, or "scollop'd plate" as Adams terms it, containing eight bi-convex lenses of graduated powers, No. 1 being the highest. The disk can be rotated beneath a fixed wheel, so that any lens can be brought into use. The flat rim of the wheel protects the lenses from dust, the arrangement thus clearly anticipating by about 130 years the principle of the modern dust-proof rotating nose-piece. It is upon this flat rim that the inscription referred to is engraved. An "eye" is formed in the periphery of the wheel, into which is screwed the ornamental body, which is simply a glorified eye-piece, made of ivory blackened and polished.

When it is desired to use the instrument as a "Single Microscope" the body is removed, and an eye-guard, very much like a lieberkuhn inverted, made of blackened ivory, is screwed in in its place in order to screen the eye from extraneous rays of light.

The coarse-adjustment is effected by releasing the pinching-screw at the back of the pillar, and raising or lowering the stem carrying the disk and body to the required position, which is shown by index numbers on the octagonal pillar; the screw is then tightened up, and an object mounted in a "slider" placed on the stage will be in focus. The

* This sub-division contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† See also Mayall's Lectures on "The Microscope," delivered before the Society of Arts in 1885, published in Journ. Soc. Arts, 1886.

numbers on the pillar from 1 to 8 correspond with the numbers of the lenses in the disk.

The fine-adjustment is actuated by the milled head of a micrometer

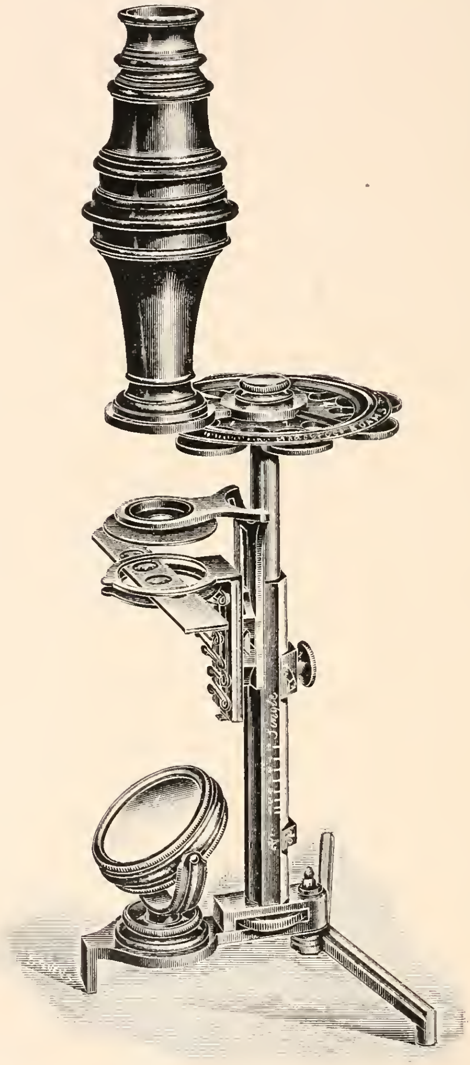

FIG. 96.

screw at the base of the pillar; this acts on a steel rod that passes up the inside of the cylindrical stem, with which it is connected when the pinching-screw is tightened up, so that, having made the coarse-adjustment and tightened up the pinching-screw, the fine-adjustment can be applied.

It will be noticed that this instrument is not a stage-focusing one, the optical parts being focused on the object as in modern Microscopes.

The principal points of difference between this instrument and its progenitors—the New Universal Simple and the New Universal Double Microscopes—which form improvements of more or less importance, are :

1. A double mirror carried on a bridle, instead of a single mirror hinged at the back.

2. The stage, and also the forceps, are carried on fittings that slide sidewise into a dovetailed groove on the pillar, instead of being fitted with shanks that were pushed into a hole therein.

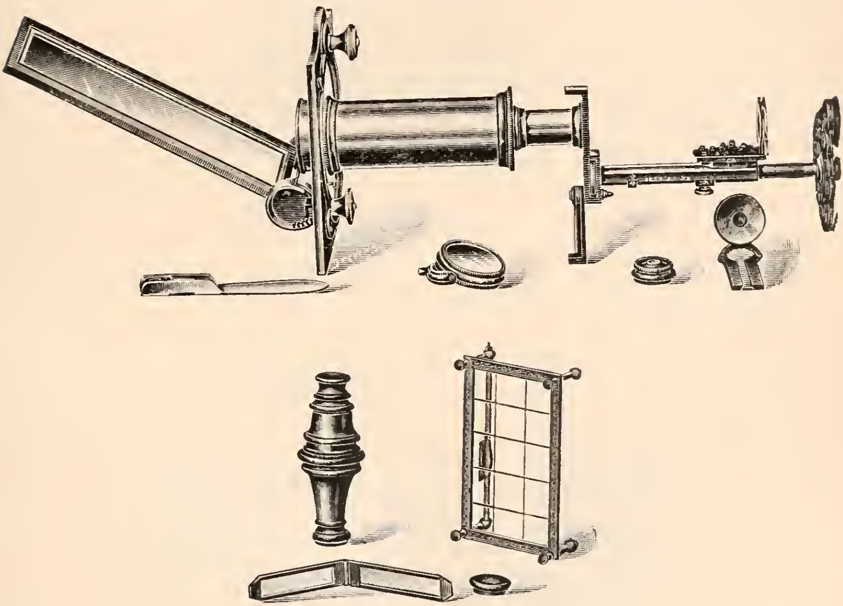

Fig. 97.

3. There are eight lenses in the disk instead of six, and three lieberkuhns instead of one. There is also a special fitting, seen in the figure, for carrying the lieberkuhns.

4. In the "Universal Double Microscope" there is a prolongation to the pillar above the level of the disk ; on this is fitted a sliding socket carrying at its lower end the rotating disk, and at its upper end there projects a bracket for carrying the body, so that the optical parts can be raised or lowered for focusing. In this instrument the body, as previously described, is inserted in an eye formed in the periphery of the fixed wheel ; by this arrangement one stand serves for both "single" and "double" Microscopes, and the upward extension to the pillar is not required.

By removing the mirror and screwed plug into which it fits, the "single" Microscope can be attached to the heliostat that accompanies it as an accessory; it then forms a solar projection Microscope (fig. 97). At the bottom of this illustration will be seen another accessory designated "A New Apparatus for confining Frogs, Mice, Bats, or any other Creatures of like Size particularly adapted to the Universal Microscope."* This apparatus consists of a rectangular brass frame $4\frac{3}{8} \times 2\frac{9}{16}$ in., upon which a frog or fish could be stretched for examination under the Microscope.

To the left of the same figure will be seen a "Contrivance to confine a small fish," whereby the circulation of the blood in its tail may be viewed "with Ease and Pleasure."†

There are other pieces of apparatus usually supplied with Microscopes at that time.

(3) Illuminating and other Apparatus.

Reichert's Reflecting Condensers for Dark-Ground Illumination, and some Auxiliaries.‡—These condensers are intended for the demon-

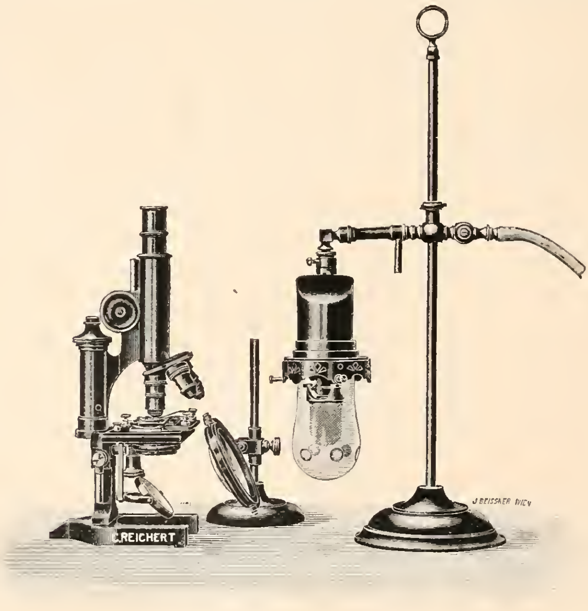

FIG. 98.

stration of ultra-microscopic particles, and, besides bringing into view ultra-microscopic particles in colloid liquids and fresh blood, serve to

* Micrographia Illustrata, by George Adams. The Second Edition, 1747, p. 42.
† Tom. cit., p. 3.
‡ Pamphlet, with above title. C. Reichert, Vienna.

produce contrasts in the illumination whereby, even in unstained preparations, structural details are disclosed which hitherto have required special staining methods. The reflecting condensers should preferably

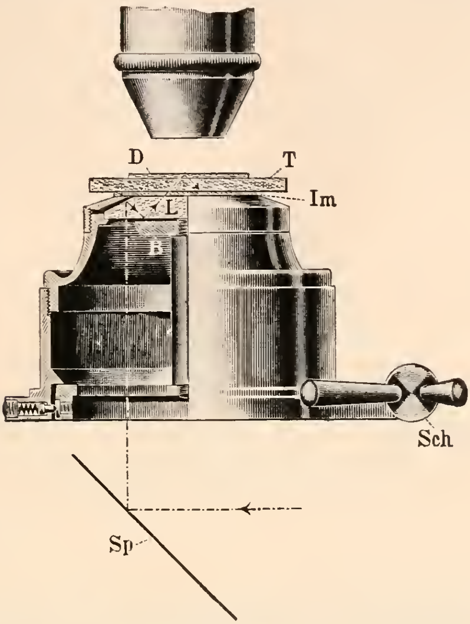

FIG. 99.

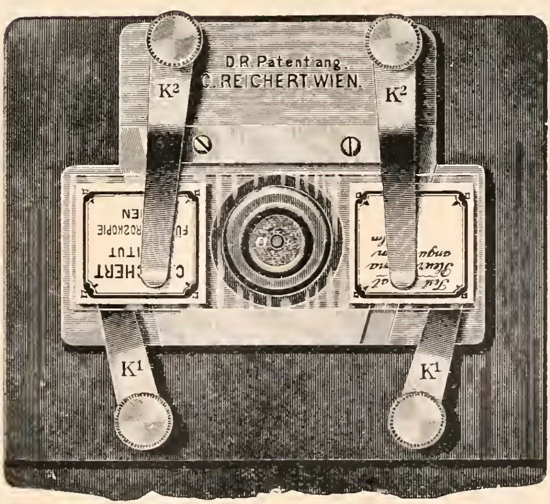

FIG. 100.

be used in conjunction with arc lamps working with a current of about 10 amperes. Any excess of power may easily be reduced with the aid of an iris-diaphragm or by increasing the distance of the lamp. Nernst lamps of 250 to 500 c.p. or the Liliput lamp should be used in conjunction with an illuminating lens and a screen on a stand. With the arc lamp and also with the Nernst and Liliput lamps it is advisable to protect the eyes by screening off all stray light with the aid of a hood. Nernst and Liliput lamps may by means of an ordinary wall plug be worked from the house supply service, but purchasers should,

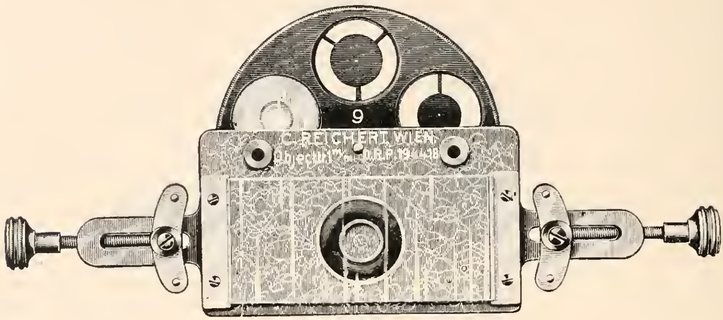

Fig. 101.

Fig. 102.

when ordering, state in each case the voltage and the nature of the current, i.e. whether it is continuous or alternating, the frequency being likewise indicated in the latter case. When gas is available, the illuminating appliances illustrated in fig. 98 may be employed. Some of the Reichert reflecting condensers have been recently modified, so as to give greater light-transmitting power, and to be suitable for special purposes.

The Reflecting Condenser, fig. 99, is, without any need of special adaptation, attachable to any Microscope provided with a sufficiently large cylinder diaphragm or Abbe condenser. It is provided with two pin stops, one being adapted for dry objectives, the other for immersion lenses. The Plate Condenser, shown in fig. 100, is adapted for dry objectives, and may be used without special adaptation on any Microscope, and is clamped to the stage by ordinary stage clips. The Universal Condenser (fig. 101), with wheel diaphragm, may be placed upon any square or round Microscope stage, and is available for use with oil-immersion and dry lenses. The wheel diaphragm furnishes a means of appropriately stopping down the pencil of light and also of conveniently moderating the light furnished by different sources of illumination and of facilitating the transition from dark-ground to ordinary illumination. The plate is attached to the stage by means of two screws. This type

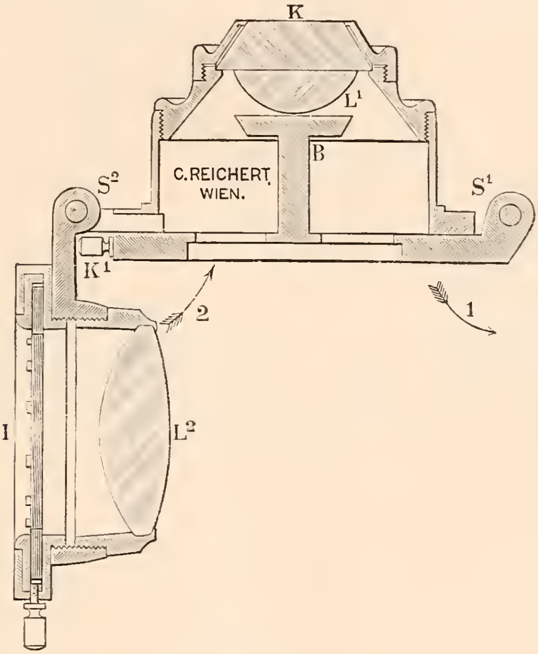

FIG. 103.

may also be procured fitted with an iris diaphragm. The Reflecting Slide Condenser is shown in fig. 102. It is mounted upon a stout glass plate which serves as a carrier, and is available for use with any Microscope. A circle ruled with a diamond upon its surface facilitates the operation of centring. The Swing-out Reflecting Condenser is shown in fig. 103. It is alternatively available as an Abbe condenser and as a dark-ground illuminator, the latter condition being obtained by swinging-out the lower lens L_2 and swinging-in the centre pin stop B. It may be used with either dry or oil-immersion lenses. Fig. 104 shows a chamber for the transfusion of liquids. It is available only for use

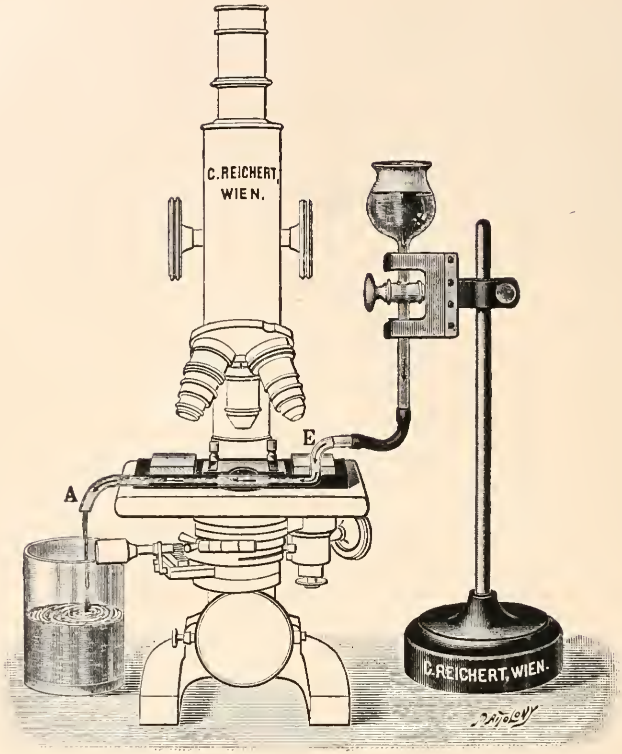

Fig. 104.

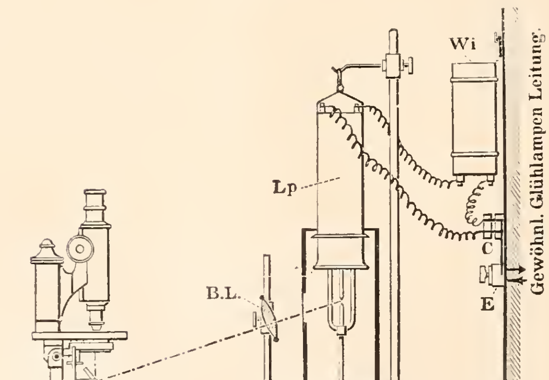

Fig. 105.

with condensers arranged for object slides, having a thickness of 2 mm. Fig. 105 shows a Liliput lamp with hood, as adapted for continuous current, and giving a light of about 500 candle power.

Divergent Microscopical Amplifier.*—A. Berget points out the inconvenience sometimes felt, owing to the excessive shortness of frontal distance, in the study of an object under a high power. Having had occasion to experience this difficulty, it occurred to him that the difficulty might be overcome by the interposition of a divergent system. His method is shown in fig. 106, one (or more) divergent lenses of short focal length being inserted in a tube sliding with body of the Microscope. The system must be inserted in such a manner that the real image $\alpha\beta$, which the objective would give were it not for the divergent lens, may be placed between this lens L and its focus F. Under these conditions it acts as a "virtual object" and gives an image real, enlarged and of the same sense, A′B′, of the object AB. It is this image A′B′ which is observed by the help of the ordinary ocular of the Microscope. In

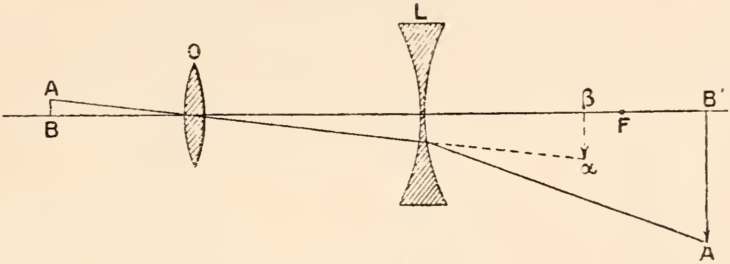

Fig. 106.

illustration of his method the author found that with a No. 3 objective focused on a micrometer divided into hundredths of a mm., the ocular being provided with a thread governed by a micrometer screw and divided drum, it was necessary to rotate the drum-head eight divisions in order to measure an interval of 10 μ. But when the divergent system was interposed, everything else remaining unchanged, a displacement of 60 divisions on the drum-head was necessary. In other experiments the frontal distance was about 1 cm. To have obtained the same magnification without the divergent system, a No. 7 objective would have been necessary, with a frontal distance equal to a small fraction of a mm. The author considers that his method could be usefully applied in many cases.

Apparatus for Measurements of the Defining Power of Objectives.†
The theory of the distribution of intensity in the image formed by a lens with circular aperture has been discussed by Lord Rayleigh in his article on "The Wave Theory of Light," in the Encyclopædia Britannica,‡

* Comptes Rendus, cxlviii. (1909) pp. 1097–9 (1 fig.).
† Proc. Roy. Soc., Series A, lxxxii. (1909) pp. 307–14 (5 figs.).
‡ See also Collected Papers, iii.

and some of the curves have been calculated by Struve.* J. de Graaff Hunter has now designed an apparatus adapted for use with the Beck photographic lens-testing bench at the National Physical Laboratory. The lens for test is held in the Beck bench so as to be free to turn about a vertical axis through its back nodal point, thus permitting the definition for oblique pencils to be readily examined. As an object, the image of which is to be examined, is employed an "edge," forming the boundary line between a half-bright, half-dark field. The "edge" is placed at the focus of a collimator, so that it may be regarded as virtually at an infinite distance from the optical system, say a photographic lens, to be examined; the image formed by such lens is viewed by a Microscope. In the focal plane of the eye-piece of the Microscope (Ramsden) is placed a fine slit, parallel to the "edge," through which alone the light passes. The slit is traversed across the field by a micrometer screw. The edge which serves as object is cut on the semi-circumference of a metal disk. Only a very small portion of the edge is actually seen in the image, and this is straight to the order of accuracy necessary. Over the other half of the circumference are sectors, cut to such a depth that the inner radius is less than the radius of the edge. The edge, at the part viewed, is uniformly illuminated from behind. When this disk is rotated, over half the rotation there appears in the Microscope field the blurred image of the edge; over the other half there is uniform illumination in the field, reduced only by 50 p.c. owing to the interposition of the sectors. In general, at an appropriate speed of rotation, there will be a flicker as passage is made from one half of the circumference to the other. A second disk placed behind the first gives the means of making a measurement. If the two disks be rotated together, over the one half of the rotation is seen the blurred image of the edge, the illumination being everywhere reduced by one-half owing to the sectors; over the other half of the rotation there is uniform illumination, which, however, can be changed, in a measurable proportion, by adjustment of the second disk relative to the first.

The author describes the practical details, and the results are found to be in complete agreement with the usual theory.

Meyer's Search-stage ii. (Perquirator).†—A. Meyer describes this auxiliary, which is made by the firm of Seibert in Wetzlar, and is numbered 72 in their Catalogue.‡ It is really an improved form of the same author's Search-stage i., designed as far back as 1901, and numbered 71 in the same Catalogue.§ The perquirator (fig. 107) is essentially a mechanical stage with two mutually perpendicular movements, and can be used as such an ordinary stage if the knob F (fig. 108) is brought to the middle position, so that the toothed wheel actuating the search-stage is put out of gear. The forward and backward movement is by such rackwork as is used in mechanical stages. But here the spindle-screw S, operating the lateral movement, is connected with an arrangement consisting of two toothed wheels, by means of which a lever H imparts a cross-movement to the preparation applied to the apparatus.

* Wiedemann's Annalen, xvii. (1882) p. 1008.
† Zeitschr. wiss. Mikrosk., xxvi. (1909) pp. 80-3 (2 figs.).
‡ Catalogue, 1909. § Loc. cit.

The lever motion is so regulated by suitable adjustment of the index J (fig. 108), movable on a graduated circular disk, that it ranges between 1 to 35 teeth. The toothed wheels are in such relation to the pitch of the screw that the movement of one tooth corresponds to 1 mm. It is therefore possible to adjust the apparatus approximately for any desired field of view whose diameter lies between 0·1 and 3·5 mm. Thus in every complete up-and-down movement of the lever the object is moved laterally almost entirely around the field. If the breadth of

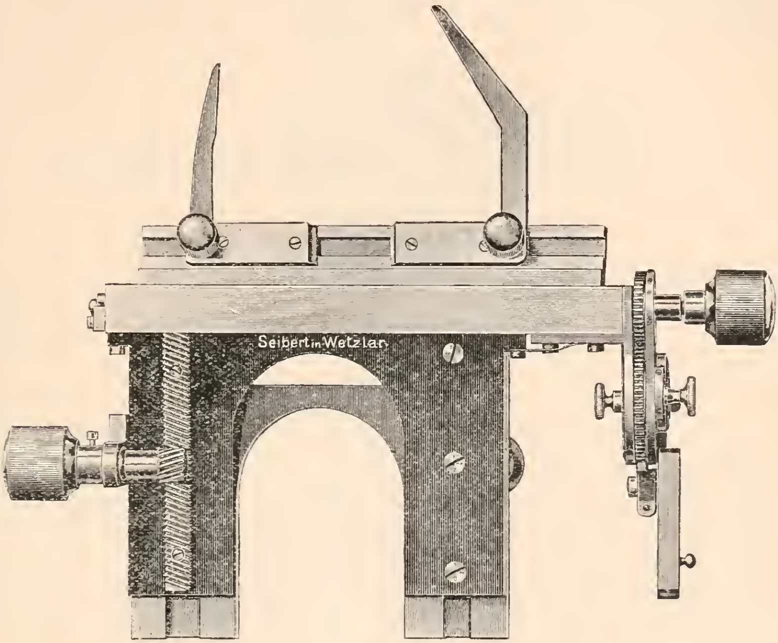

FIG. 107.

the field is measured, the adjustment in millimetres is known, without further observation, by the position of the upper sharp edge of the index J. If the diameter of the field of view is unknown, it may be ascertained in the following manner. An object-slide is marked in any suitable way, an object-micrometer is inserted, and the mark so adjusted that it is exactly at the left boundary line of the view-field. The lever H is now turned forward and downwards until it reaches the pin *p*; the knob F, which at first was central, is moved to the right, the screw of the index is loosened, and the index pushed close up to the lever H. The observer now carefully draws the lever towards himself, and at the same time follows in the Microscope the movement of the mark. When the mark has reached the opposite verge of the view-field, the index is clamped, and the range of lever-play is then accurately known. The small knob F is in connection with a small spring-lever concealed by the strong lever H, and clicks in three resting-spots. At the centre of one of these spots the two teeth z of the cog-wheel lying behind the lever H are released, so that H goes out of gear. When F is moved to the right spot, the object is also moved to the right through a distance of the field-diameter. When F is moved to the left resting-spot, the object is similarly moved the distance of a diameter to the left. The apparatus, it will be observed, bears some resemblance to Engel's mechanical stage, as made by Leitz. But the distinctive peculiarity of the perquirator is that its movement is adjusted for a diameter of the new field. Fig. 107 shows the perquirator in plan. Fig. 108 shows it in lateral elevation.

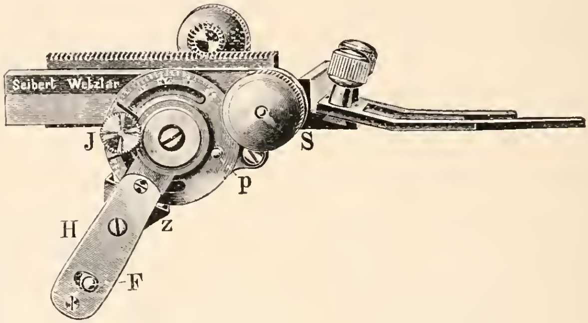

FIG. 108.

New Method of Measuring Hardness.*—V. Pöschl has devised a combination of sclerometer and Microscope for the purpose of measuring hardness with more precision than is possible by the ordinary methods. His sclerometer (fig. 109) consists of a zinc plate on three levelling screws, and a circular level is attached to the plate. When the plate is level the axis of a certain lever is also horizontal. This lever carries at one end the scratching-point surmounted by a scale-pan for receiving any suitable weight. A pointer attached to the lever-axis works on a graduated arc (something like the pointer of a balance), and insures that the lever remains at a constant inclination. The beam carrying the lever slides up and down in a hollow vertical pillar attached to the zinc plate, and can be clamped at any required height. The crystal, or other hard body to be tested, is set, so as to have the tested surface horizontal on a specially designed bearer. This bearer rests on a carriage working on three runners attached to the zinc plate. A cord running through a system of pulleys pulls the carriage with the bearer and crystal across the zinc plate, and so brings the crystal into contact with the scratching-point. Although there are other methods of estimating hardness, the author considers that it should be taken as proportional to the weight pressing upon the scratching-point.

Next, it is necessary to examine microscopically the breadth and depth of the scratch upon the crystal, and hardness is now considered to be inversely proportional to the size of the furrow. The instrument used was Reichert's Metall-mikroskop, as designed by Rejtö. It was combined with the sclerometer in such a way that the crystal, after being

* Zeitschr. wiss. Mikrosk., xxvi. (1909) pp. 104–10 (1 fig.).

scratched, came immediately under the objective, the scratch bisecting the field. With strong magnification the scratch appears as a band. Its breadth can be accurately measured with an ocular micrometer and its

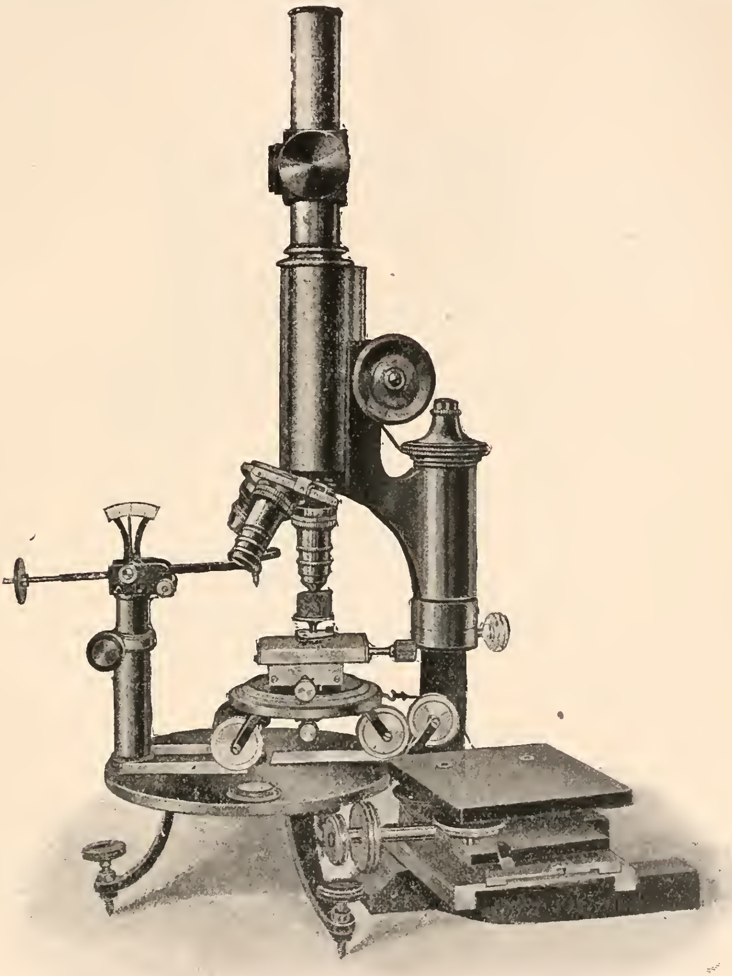

Fig. 109.

depth with a micrometer-screw, to a limit of 2 or 3 μ. In order to get a serviceable result as regards the comparison of various crystals, the diamond scratching-point must remain completely unaffected, a condition which can be examined by the Microscope. The author, however, had nothing to complain of in this respect. He also found that the velocity of the carriage had no perceptible effect upon the dimensions of the scratch, which, by the way, was frequently invisible to the naked eye. His experience seems to warrant the conclusion that the scratch obtained and measured by his method is a trustworthy indication of the hardness of the material.

Swift and Son's Stage Goniometer.—This goniometer (fig. 110), which is a modified form of Professor Miers' Stage Goniometer,

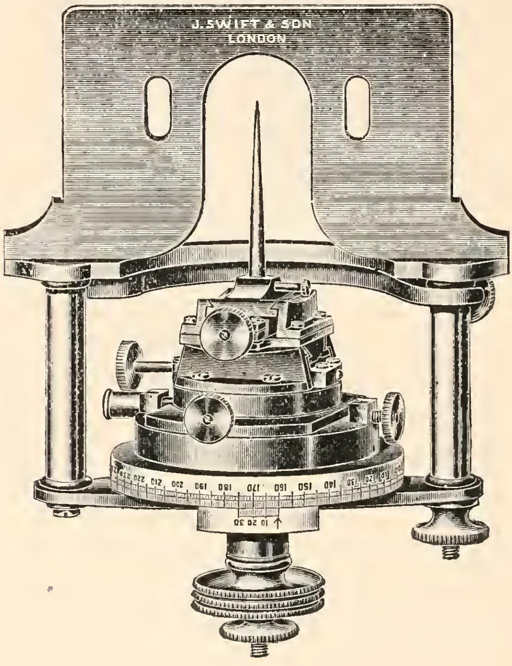

FIG. 110.

designed by Professor H. L. Bowman, is clamped by two screws to the stage of a "Dick" petrological Microscope. It is fitted with complete arrangements for adjusting and centring a crystal similar to those employed on the large instruments. By means of these adjustments a small crystal, mounted on the end of the steel pin, can be brought to coincide with the turning axis, and adjusted so that one of its edges is parallel to this while it remains under observation. The instrument is specially designed with a view to great rigidity and delicacy of adjustment in order to enable a crystal mounted on it to be observed under high powers. It is, therefore, invaluable for the examination of minute crystals, particularly such as show twin lamellation or similar complex structures, in respect to etching pits and extinction angles on different faces. The optic-axial angle of a bi-axial crystal or fragment can be measured with absolute accuracy. The crystal can, if necessary, be immersed in a drop of oil of suitable refractive index placed between the objective and condenser.

The radial dovetails, whose arcs are both struck from a common centre —the point of the steel pin—are built solid, brass bearing on gun-metal. They are operated by specially arranged steel tangent screws of 0·5 mm. pitch. All movements can be clamped after adjustment. The large circle is divided to 0·5° reading to 1 in. by a vernier.

Watson's New Holos Immersion Paraboloid.—This apparatus (fig. 111) gives an intensely black background on a brilliantly illuminated object with high power objectives up to 0·95 N.A. The maximum effect is obtained by using a brilliant light and a bull's eye. It is specially suited for the exhibition of unstained living bacteria.

Fig. 111.

(4) Photomicrography.

Photography by Reflection under Contact.*—E. E. Fournier d'Albe, under the above title, describes a new process likely to be of interest to photographers of all kinds. In the usual methods of contact photography a copy is taken of the original or negative by allowing light to pass through the latter on to a sensitive surface: the resulting picture is due to differences in opacity in the various points of the original or negative. But the author's new process consists in transmitting the light in the reverse direction, and in producing a picture, not by differences of opacity, but by differences of reflecting power in the original. The obvious objection to such a method is that the sensitive film, being exposed to a uniform incident illumination coming through the back of the plate, will be uniformly fogged, and the resulting positive will be marred by a brightness which invades and obliterates all the dark portions. If this difficulty can be overcome, we obtain a method of copying any flat picture or design without a camera; and we avoid the difficulties of distortion, curvature of field, chromatic and spherical aberration, and so on. When the original to be copied has no half-tones, it is possible, by suitable exposure and development, to eliminate the fog entirely. The general principle is to employ exposures and developers which, in ordinary photography, "suppress the detail in the shadows," or, in other words, confine the developed image to those portions which have received the maximum illumination. The author gives details and illustrations of the method.

But the fog may also be eliminated by reduction and subsequent intensification. Howard Farmer's reducer (potassium ferricyanide and hyposulphite of soda) dissolves away the fog more than the full tone if sufficiently concentrated. The negative is intensified with mercuric chloride and silver-nitrate. The best results are obtained with slow plates of the "photomechanical" class, and the developer used was the following:—Solution No. 1: Hydroquinone 80 gr., pot. metabisulphite 120 gr., pot. bromide 10 gr., water, etc., 10 oz. Solution No. 2: Caustic potash 200 gr., water, etc., 10 oz. Equal parts of both solutions are mixed. The best fixing agent is potassium cyanide, on account of its solving

* Sci. Proc. Roy. Dublin Soc., xii. (1909) pp. 97–100 (1 pl.).

action on thinly deposited silver. The author, however, used the ordinary "hypo" bath.

Excellent paper negatives were obtained with rapid bromide papers, and also with gas-light papers. On printing positives from them in the ordinary way, the grain of the paper negative disappears, as it is automatically compensated by the grain within the paper which gave rise to it. Printing-out papers also give negatives which can be used for printing positives on bromide paper without previous toning and fixing, but the exposure has to be very long.

In applying the process to black or white originals, certain advantages are gained over the ordinary methods with the camera :—1. The reproduction is of the exact size of the original. 2. The sharpness of definition is only limited by the size of the silver grain in the plate. 3. All differences in the angle of reflection of light by the original are avoided, all the effective light emerging at right angles to the surface.

Chronophotomicrography.*—L. Chevroton points out the importance of photographing moving objects at known intervals of time, and describes the arrangements she has successfully used for the purpose. She employs a Zeiss optical bench with the usual fittings and a voltaic arc, as light source, of 20–25 amperes and 60 volts continuous current. But in front of the water cooler a sector-disk is inserted capable of revolution at a known rate. Thus, if a sector cuts the optical axis 30 times a minute, and the interval between the sectors is about 11°, 30 images are received per second and each of these has $\frac{1}{960}$ in. of pose. A Zeiss stand is fixed vertically on the general support of the camera and independently of the optical bench ; the chronophotographic apparatus is itself in a direct connection with the stand by means of a telescopic tube in order to avoid all loss of light, an essential condition. The sector-disk may be operated by hand or by a motor.

Mirror-reflex Camera for Photomicrography.†—This apparatus was designed by W. Scheffer mainly for instantaneous photomicrography, but has been found to succeed well with either transparent light or with dark-ground illumination. It has, therefore, been found useful to the microscopist for other purposes, including that of the cinematography of microscopic objects. The task before the designer was to devise an arrangement by which the movements of the object could be observed on the ground-glass screen, while at the same time all the arrangements necessary for photomicrography were in readiness and could be brought into instantaneous action. Fig. 112 shows diagrammatically the principle of the apparatus. Two mirrors, A and B, are arranged in a wooden case. The beam of rays proceeding from the Microscope comes through O, and is twice reflected at the mirrors A and B on to the ground-glass screen M. The ocular end of the Microscope is connected in light-tight fashion by the customary funnel with O. In V is a window arrangement, which is opened when the mirror A is rotated round the axis D from the position D E into the position D E'. If the window V is opened, the light of the Microscope travels

* C.R. Soc. de Biol., lxvi. (1909) pp. 340–2 (1 fig.).
† Zeitschr. wiss. Mikrosk., xxvi. (1909) pp. 111–15 (3 figs.).

rectilinearly in the direction of the arrow on to the sensitive plate P in the cassette C. The space in front of P is completely dark when V is closed. For the purpose of long exposures V may be removed. When the operator judges that the proper moment has arrived, he pulls a lever at G, thus opening V and allowing the light to fall on the sensitive plate at P. The author adds a figure showing how his apparatus is adapted to Zeiss' large photomicrographic camera. The space in front of P is occupied by the bellows, and the light-path from O to M has to equal that from O to C.

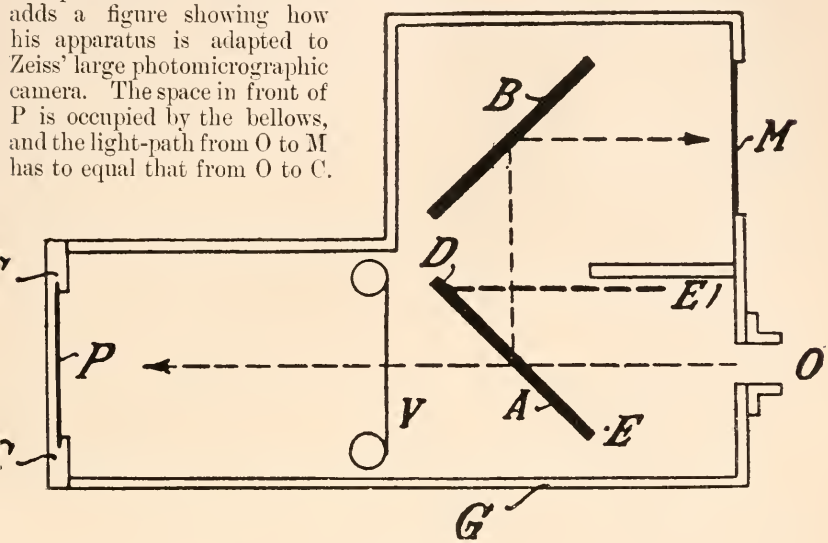

FIG. 112.

(5) Microscopical Optics and Manipulation.

Simple Arrangement for determining Microscopically the Index of Refraction.*—E. Clerici describes his method of carrying out a simple mode of obtaining the refraction-index with an accuracy sufficient for mineralogical and petrographic purposes. His method involves the use of an object-slide fitted with a cylindrical cell, to the bottom of which is fixed a small glass prism. A ray passed through this will, of course, be refracted, and its duration can be measured by the cross-threads of the ocular micrometer. If the cell be filled in succession with liquids of known refractive indices, and a coverslip added, a curve can be constructed and the whole arrangement being thus calibrated is adapted for the investigation of an unknown liquid. The author discusses the advantages of several varieties of simple and compound prisms.

CHEVROTON L., AND F. VLÈS.—**Examen de la striation musculaire en lumière ultra-violette.** *C.R. Soc. Biol. Paris*, lxvi. (1909) pp. 1057–9.

(6) Miscellaneous.

Telescopic Vision.†—Under the above title Johnston Stoney discusses the defects of the telescope, and inquires into the process by

* Atti d. Reale Acad. dei Lincei, xviii. ser. 5 (1909) pp. 351–5 (6 figs.). See also xvi. (1907) p. 336.
† Phil. Mag., xvi. (1908) Aug., Nov., Dec.

which nature constitutes those images which are formed in optical instruments or on the retina. Two images, and their relation to one another, are considered. One of these is the image of the celestial object presented to the telescope or to the eye. The other, referred to as the concentration image, can be formed by the same identical light, but is an entirely different image. The method of analysis which has proved to be the most efficient in tracing out how images are actually formed by nature is the analysis of the light, within any space occupied by a uniform medium, into its constituent undulations of flat wavelets. It is by the interferences of these undulations that the image is formed. The author describes an apparatus for making experiments which will disclose the imperfections of necessity existing in the images furnished by astronomical telescopes, and which will indicate the causes of these imperfections and how they may be mitigated. He also discusses why it is that, when a large and a small object exactly similar to each other are examined with the same telescope, the large one will be seen satisfactorily, while the small one, though of precisely the same shape, will, if small enough,

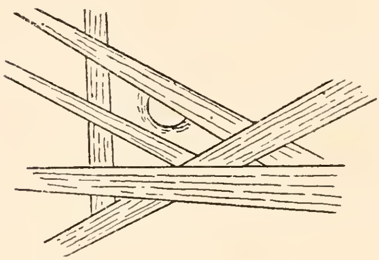

Fig. 113.

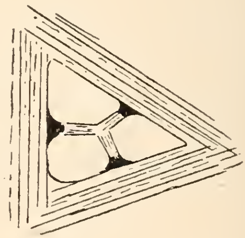

Fig. 114.

appear when viewed through the telescope to be transformed into something unlike itself.

He appeals to microscopical experiments * in illustration of his subject, and describes certain observations on the proboscis of a blow-fly. Fig. 113 shows an arrangement of hairs on a certain specimen. A small triangular patch of bright light happened to be shut in between three of the hairs or bristles which grow near the base of the proboscis. These hairs had been pressed in the mounting of the specimen so that they lay near to one another and nearly in a plane perpendicular to the optic axis. Another, and thinner hair, which we may call the canal, divided the triangle of light into a smaller triangle below and a quadrilateral space above the canal. Within this quadrilateral was seen about half of the base of another small hair, presenting the semicircular appearance in fig. 113, and being somewhat darker on the right-hand part of the semicircle than on the left. The rest of this hair lay outside the triangle of light to which attention is being called. This object was examined through one of Zeiss' 24 mm. apochromatics, over which an iris diaphragm had been fitted to enable the observer to diminish its aperture to any desired extent. The succession of appearances while

* Phil. Mag., xvi. (1908) pp. 976–7.

the aperture was being diminished was most suggestive. The object was fairly well seen until the aperture became rather small, but then on further contraction of the aperture a succession of new phenomena sprang into existence, until at a certain stage the appearance became that represented in fig. 114, and was then utterly unlike the real object. The semicircle has disappeared, and instead of it and the one straight canal across the triangle, we have what appear to be three canals of nearly equal thickness, and abutting nearly perpendicularly upon the three sides of the entire triangular space. And at the same time "carets" have developed themselves at the outer ends of these three optically-produced canals. These unsteady appearances, which sometimes metamorphose an object into something utterly unlike itself, are of the same kind as those by which the astronomer, who occupies himself upon minute details, is but too likely to be misled, unless he avails himself of some such aids as those which the author has ventured in his memoir to recommend. [In looking at fig. 114 the reader is requested to exercise his imagination, for none of the features as seen in the Microscope had the hard outlines of the diagram. The three "canals" were dusky streaks with straight but nebulous edges, and the boundary of the triangular bright space was also nebulous. The "carets" were the darkest part of the image.]

Royal Microscopical Society's Microscopes at the Franco-British Exhibition.

The Royal Microscopical Society contributed, as announced at the May Meeting of the Society last year, a collection of Microscopes to the British Science Section of the Franco-British Exhibition. The collection was illustrative of the development of the Microscope from the earliest times, and comprised, in addition to twenty-three instruments belonging to the Society, four which were lent by Fellows: two by Sir Frank Crisp and two by Mr. E. M. Nelson.

The collection was distributed into five groups as follows:

1. Simple Microscopes.

2. Compound instruments of the Scarlet and Culpeper type, in which the lenses are carried in a body which slides in a ring for the purpose of focusing, and in which no attempt is made to obtain achromatism.

3. Instruments of a more highly developed type, in which screw motions are introduced for the purposes of focusing and the instruments were what was at the time called the universal type, that is to say, were adapted to be used either as simple or as compound instruments, and fitted for the observation of opaque or transparent objects under various conditions of stage and illumination. They, however, are non-achromatic.

4. The Catoptric type, in which an attempt was made to get over the difficulty of achromatic aberration by substituting mirrors for lenses in the objective. This type of instrument was represented by a single specimen (Cuthbert's reflector Microscope).

5. The group of achromatic Microscopes, leading up, in their full development, to the modern instrument.

The following is a descriptive list of the instruments exhibited.

Class 1.—Simple. (*To illustrate the Early Type of Simple Microscope.*)

LEEUWENHOEK. (Copy.) About 1673.

Type—Simple Microscope.

Two thin metal plates are fastened together by rivets. Between these plates a very small double convex glass lens is mounted between two concavities provided with minute apertures. The object is held in front of the lens on the point of a short pin, the other end of which screws into a small block or stage of brass, which is riveted on the end of a long coarse-threaded screw acting through a socket angle-piece attached behind the lower end of the plates. It is with such instruments, of the rudest kind mechanically, that Leeuwenhoek astonished the world with his discoveries of Infusorians, Bacteria, and other microscopic forms of life.

Described and figured in Mayall's Cantor Lectures, 1885, p. 20, and in Journ. R.M.S.,, 1886, pp. 1047–9.

Lent by Sir Frank Crisp.

MUSSCHENBROEK. Date, about 1690.

Type—Simple Microscope.

Consists of a hollow handle, through the length of which slides a tube, which is controlled by a knob at the base. Various forms of object-holders can be inserted in the tube, whilst the handle is provided with hinge-joints set at right angles, and by means of two thumb-screws, acting against springs, the object can be moved laterally and adjusted to the focus of the lens. The small biconvex lenses are mounted between two thin plates of brass, fitted to slide in metal grooves in the carrier, over which slides a metal box, with a pivoted sector of diaphragms. This is the first time this system of changing diaphragms occurs, and it is the precursor of the modern wheel of diaphragms. The carrier is connected to the handle by means of a strong brass wire bent to two right angles; this arrangement gives considerable scope for movements forward or backward, and laterally.

Described and figured in Zahn's Oculus Artificialis, 2nd ed., p. 783, and in Mayall's Cantor Lectures, 1885, p. 24.

Lent by Sir Frank Crisp.

LIEBERKUHN. About 1738.

Type—Simple Microscope.

Lieberkuhn devised a combination of a simple biconvex lens, mounted in the central aperture of a polished metal reflector, which formed a small hand Microscope for the special purpose of viewing opaque objects. This construction, in an improved form and applied to achromatic object-glasses, is in use at the present day.

The present model shows this form as made by Adams. See Adams' Micrographia Illustrata, 1747, p. 16.

WILSON'S Screw-Barrel Microscope. Invented about 1702.

Type—Simple Microscope.

Two specimens of this instrument are exhibited, the one showing its adaptation to the examination of transparent objects, the other, its use with opaque objects. In the one case the object-slide is held by a spiral spring and focused by a screw-barrel, which also carries an illuminating lens. In the other case a rod, provided with forceps, replaces the object-slide, and a lens-carrying arm enables the magnifier to be suitably displaced for viewing an object held by the forceps. This was a very popular model in the eighteenth century.

See Phil. Trans., xxii. pp. 1241–7.

Described and figured in Journ. R.M.S., 1905, p. 740.

CLASS 2.—COMPOUND. (*To illustrate the Old "Double Microscope."*)

JOHN MARSHALL'S "Double" Microscope. Invented about 1704.

Type—Compound Microscope, uncorrected.

Points to be noted :—(1) The provision of a screw for fine focusing adjustment; (2) the stage clamped to the pillar. Early models of this make of Microscope had a ball-and-socket joint at the base of the pillar, but no mirror as late as 1718. In the present specimen the ball-and-socket is replaced by a rigid pillar, and the addition of a mirror and modifications of the stage show that it is of somewhat later construction—about 1744.

This instrument was described in the original advertisement of it as "John Marshall's New Invented Double Microscope for Viewing the Circulation of the Blood." The word "double" here signifies that it was a compound instrument provided with an objective for forming an image of the object and an ocular for viewing the image so formed. Concerning this instrument see Mayall's Cantor Lectures, 1885, p 37.

CULPEPER'S Compound Microscope. Date, before 1738.

Type—Compound, uncorrected.

It will be observed that this is a modification of Wilson's simple Microscope. A body-tube of ivory, with draw-tube, is provided for the purpose of transforming it into a compound instrument which is mounted on a pillar with a ball-and-socket joint. The ball-and-socket was a favourite mounting contrivance with the early makers. It was fitted to Hooke's instrument, and was adopted in his earlier models by John Marshall. Its use for this purpose has been now entirely abandoned in favour of the compass hinge.

This instrument is described and figured in Mayall's Cantor Lectures, 1885, p. 34.

CULPEPER AND SCARLET. Invented about 1738.

Type—Compound, uncorrected.

This tripod form of Microscope stand, mounted on a wooden box, was a favourite model for more than a century. It was copied and made by successive opticians with many variations in form, material, and finish until about the middle of last century. The body of the present model is made of wood and cardboard, and the focusing is done by sliding the body. There is no fine-adjustment. The object-glass is a single biconvex lens, and the eye-piece has two lenses. A mirror with ball-and-socket motion is fixed to the box foot.

This instrument is described in R. Smith's "Opticks" (Cambridge, 1738), ii. p. 407, and figured in Mayall's Cantor Lectures, 1885, p. 40.

NATHANIEL ADAMS. About 1740.

Type—Compound, uncorrected.

This is of the Culpeper and Scarlet pattern, and is rendered even more unhandy than its original by the addition of a fourth pillar in the space surrounding the stage. This inconvenience was incurred, no doubt, for the sake of the greater rigidity secured by the fourth pillar —a distinct advantage in focusing the instrument. Attention may be drawn to the elaborate chain of ball-and-socket joints by which a condensing lens is connected to the stage.

Presented to the Society May 17, 1905. See Journ. R.M.S., 1905, p. 397.

DOLLOND. About 1816.

Type—Compound, uncorrected.

This again is of the Culpeper and Scarlet pattern, but shows a great advance in its mechanism, being made all in brass and fitted with a rack-and-pinion focusing arrangement. This specimen is remarkable for its date as showing the persistence and continued improvement of an obsolete type of instrument at a time when instruments of a much better design were being produced.

Described in the Journ. R.M.S., 1901, p. 227.

JOHN CUFF'S "Single" and "Double" Aquatic Microscope. Date about 1760.

Type—Alternatively Simple or Compound, uncorrected.

Compared with its predecessors, and in particular with instruments of the Culpeper and Scarlet model, the present instrument shows distinct improvements. The following points may be noted :—1. It is provided with a fine-adjustment which focuses the lens and body, not the stage. 2. The instrument is inclinable. 3. The stage has lateral movement on a pivot. 4. The pillar is mounted excentrically on its oval base-plate and is capable of rotation, which gives the Microscope greater stability in different positions. 5. It can be folded for portability. 6. A clip is provided to clamp the slide. This is the earliest known example of slide clip.

Described and figured in Journ. R.M.S., 1898, p. 675.

Lent by Mr. E. M. Nelson.

Class 3.—Compound and Simple Combined. (*Complex Instruments, showing the development of the Stand, and illustrating the use of the "Double" Microscope, in combination with Simple Microscopes, prior to the introduction of the Achromatic Objective.*

JOHN CUFF'S Compound Microscope. Invented about 1744.

Type—Alternatively Simple or Compound, uncorrected.

The inventor of this model made a distinct improvement in the mechanical construction of the Microscope, and it forms an important link in the evolution of the instrument. The stand is firmer and more rigid, and altogether more handy, whilst the stage is more accessible ; the fine-adjustment applied to the body has greater delicacy. After Cuff's death this model was made by various opticians, such as Adams, Dollond, Nairne, etc., with various additions and improvements.

Described by Baker, "Employment for the Microscope," 1753, pp. 442-6.

Presented to the Society Nov. 16, 1904. See Journ. R.M.S., 1904, p. 727.

BENJAMIN MARTIN. 1760.

Type—Alternatively Simple or Compound, uncorrected.

The maker of this instrument devised numerous improvements in the mechanism and optical arrangement of the Microscope, and the present model is an important link in its development. For the first time there is a slow and fine movement for focusing, by rack-and-pinion and by screw, both applied to the stage, with the constant action of a spring to check the motion. A small compass-joint at the top of the pillar allows the carrying-ring to be turned out of the way when the instrument is used as a simple Microscope.

Presented to the Society March 21, 1900. See Journ. R.M.S., 1900, p. 269.

BENJAMIN MARTIN. 1771.

Type—Alternatively Simple or Compound, uncorrected.

This exceedingly elaborate instrument, of exquisite workmanship, with every conceivable movement, is said to have been made for King George III. Its authentic description is "Benjamin Martin's Large Universal Microscope." The meaning of the word "universal" is that it can be used for viewing opaque or transparent objects with either a single or double lens combination, that is to say, either as a simple or as a compound instrument, and that it possessed, in addition, the joints and accessories necessary to enable the user to direct his gaze in a horizontal, vertical, or inclined direction at his choice, and to carry the body of the instrument over the different parts of the stage by what was then called the "aquatic" traversing motion. The triangular upright stem has a compass joint at its base, and is fixed to an elaborate foot, over which it is adapted to rotate. This foot is, in most descriptions of the instrument, erroneously described as a tripod. The three feet do not, in fact, support the instrument, but serve only to steady it, the weight being carried by the knob in the middle of the foot. The stage has micrometric movements in three directions; it moves the object over a wire scale in the eye-piece. This method of micrometry was invented by Benjamin Martin, who also wrote a book about it. The double mirror, as well as the stage, can be raised and depressed by rack-and-pinion. The compound body can be removed and replaced by a simple Microscope; the stage also can be removed and replaced. Provision is made for holding and illuminating living objects and large opaque specimens. To accommodate the instrument to the case it has been placed in the horizontal position, and its stage has been dismounted and laid upon the table at the foot of the instrument.

This Microscope is fully described in the Transactions of the R.M.S. of 1862, p. 31.

GREGORY AND WRIGHT. 1785.

Type—Alternatively Simple or Compound, uncorrected.

The makers of this instrument were successors to Benjamin Martin. It will be noticed that they follow his lead by making the stem inclinable by a joint at its base, where it is fixed to a folding tripod foot. The body is attached to a movable arm, which, in turn, is carried by the stem. This arm can be swung about the axis of the stem, and moved to and fro in its socket, these movements facilitating the exploration of a large specimen. In consequence of this adaptation such Microscopes were, in the latter half of the eighteenth century, called "aquatic." Focusing is effected by rack-and-pinion, which move the stem and body, whilst the stage is fixed. This Microscope has a rotating multiple lens-carrier nose-piece, invented by Père Cherubini d'Orléans.

Described and figured in Journ. R.M.S., 1908, p. 154.

SHUTTLEWORTH. 1786.

Type—Alternatively Simple or Compound, uncorrected.

The stand of this instrument is a somewhat later imitation of the Benjamin Martin type. The triangular stem has a compass-joint at its base, by means of which the whole Microscope is inclinable. The stage has rack-and-pinion focusing movement. The body is fixed to a movable and rotating arm, and carries François Watkins' rotating multiple lens-carrier nose-piece. The mirror and condensing lens slide on the triangular pillar.

Described and figured in Journ. R.M.S., 1908, p. 365.

JONES. 1798.

Type—Alternatively Simple or Compound, uncorrected.

This model follows an earlier form of François Watkins, inasmuch as the compass-joint making the Microscope inclinable is raised to the top of an upright stem, fixed to a tripod folding foot. To the joint is fixed a square limb on the top of which a short arm, movable by rack-and-pinion, supports the body of the Microscope. The stage moves on the limb by rack-and-pinion, which serves for the focusing of the object. The mirror and condensing-lens slide on the same square limb. The object-glasses are contained in a rotating multiple lens-carrier nose-piece.

The instrument was described by its makers (W. and S. Jones, of Holborn) as the "most improved" Microscope, a description much better justified than superlatives—and especially the superlatives used by salesmen—commonly are, for this instrument does, in fact, represent the culminating point reached by the dioptric instrument before the introduction of the achromatic objective.

Described and figured in Adams' "Essays on the Microscope," 2nd ed., 1798, p. 99.

Class 4.—Reflecting.

CUTHBERT'S Reflecting Microscope. About 1827.

Type—Compound: Catoptric.

The attempts made at the close of the eighteenth and beginning of the nineteenth centuries to produce achromatic object-glasses for the Microscope having failed, owing to technical difficulties, the maker of this Microscope attempted to produce achromatism by means of mirrors, carrying into effect a suggestion originally made by Newton which one or two other makers had followed up. Cuthbert's instruments are said by Mayall to have been the best of their type. The magnification of objects is here effected by means of very small reflecting specula, and the result for low and medium powers was very fairly satisfactory. The body is fixed by a compass-joint on the top of the telescopic stem supported on a folding tripod. The focusing is effected by moving the stage, and the latter has rectangular motion.

Described and figured in Mayall's Cantor Lectures (1885), p. 58.

Class 5.—Instruments Fitted with Achromatic Objectives.

DELLEBARRE'S "Microscope Universel." About 1777.

Type—Compound : Achromatic.

This stand is a French model on the lines of the English Microscopes of the period. The square limb is fixed on to a scrolled folding tripod foot, and has a hinge about its middle by means of which the upper part can be inclined. The body is fixed to an arm which slides in a rotating socket at the top of the limb. The concave mirror and condensing lens slide on the limb. The arm carrying the stage has a pinion moving in a rack cut in the limb for the purpose of focusing.

Dellebarre endeavoured to obtain achromatism by the use of oculars built up of crown and flint glass lenses, the excessive correction of the ocular compensating for want of correction of the objective. His plan was not, however, successful, and the first practical achromatic Microscope was not produced until fifty years after his time.

Described and figured in Petri's "Das Mikroskop," p. 162.

LISTER-TULLEY Microscope. Made by James Smith, 1826.

Type—Compound : Achromatic.

This Microscope was designed by Mr. Joseph T. Lister, who also himself made an achromatic object-glass for it. This is the first achromatic Microscope made in this country. A folding tripod foot supports a pillar, on the top of which is hinged an arm which supports a body having two draw-tubes and a focusing rack at the side. A substage is provided, fitted with a compound condenser. The stage has rectangular movements by means of two pinions, one of which is placed in a vertical position. Steadying rods are used to support the body in the inclined and horizontal positions.

Described and figured in Journ. R.M.S., 1900, p. 550.

Lent by Mr. E. M. Nelson.

CHEVALIER "Microscope Achromatique." 1834.

Type—Alternatively Simple or Compound : Achromatic.

The brothers Chevalier, of Paris, were the first opticians to produce, about 1823, practically useful achromatic object-glasses for the Microscope. The present instrument is an early specimen made by Charles Chevalier. The mechanical model followed is still that of Jones's "most improved," with various modifications. The arm carrying both the body and the limb is fixed by a compass-joint to the top of the stem, which itself is supported on a flat solid tripod. Focusing is effected by rack-and-pinion to the stage, which itself is mechanical in one direction only.

Described and figured in Chevalier's "Des Microscopes et de leur Usage," 1839, pp. 98–100, pl. 3.

CHARLES CHEVALIER. About 1840.

Type—Alternatively Simple or Compound : Achromatic.

This exceedingly well made instrument is an enlarged and improved Microscope upon the model of the preceding, embodying a number of devices for use in an erect or in a horizontal position, and for the observation of chemical reactions. It is described by its maker as his "Microscope Achromatique Universel." The focusing arrangements, both coarse and fine, are still attached to the stage, whilst the body remains fixed. In the horizontal position a right-angled prism is used for deflecting the rays into the tube. The mirror is plane and concave, and is movable by rack-and-pinion. The whole Microscope is exceedingly steady, and all the motions very smooth.

Described and figured in Chevalier's "Des Microscopes et de leur Usage," p. 88, pl. 4.

HUGH POWELL. 1839.

Type—Compound : Achromatic.

This Microscope is of very great interest, because it embodies new features which have now been very generally adopted in the design of the Microscope. The body, stage, and mirror are carried by the limb, which itself is attached by a compass-joint to an upright telescopic pillar raised on a solid tripod. The coarse-adjustment by rack-and-pinion for the first time moves the body of the Microscope, but the fine-adjustment is applied to the stage by a wedge acted on by a micrometer screw. In this model also Hugh Powell systematically applied the method of "springing" in the movements to prevent loose action ; its application to the pivots of the mirror can be well seen.

Described in Journ. R.M.S., 1901, p. 728.

HUGH POWELL'S Large Microscope. 1841.

Type—Compound : Achromatic.

This Microscope is one of three which the Council of the Microscopical Society of London, soon after its formation, ordered of the three best makers of the day—Hugh Powell, James Smith, and Andrew Ross. This almost too elaborate and substantial stand was considered the best of its day, and embodies all the most refined movements and apparatus the maker was able to devise. The body is moved by rack-and-pinion, and is attached to a hollow triangular bar. The fine-adjustment actuates the stage. Originally this was a monocular Microscope, but the binocular body with Wenham's prism was fitted to it after the invention of the latter in 1863.

Described and figured in Journ. R.M.S., 1900, p. 285.

JAMES SMITH. 1841.

Type—Compound : Achromatic.

This stand was made in execution of an order given by the Council of the Microscopical Society of London in August 1840, and has become a model on which many English stands have since been made. A substantial pillar mounted on a solid tripod supports a grooved limb, which itself carries directly the body, stage, and mirror. Coarse-adjustment is effected by rack-and-pinion moving the body, whilst fine-adjustment for the first time by lever and screw acts on the nose-piece only. The mechanical stage has rectangular motion, and can be rotated.

Described and figured in Microscopic Journal, ii. p. 1, and in Journ. R.M.S., 1900, p. 553.

ANDREW ROSS. 1842–3.

Type—Compound : Achromatic.

In execution of an order by the Council of the Microscopical Society of London in 1841, Andrew Ross produced this type of Microscope. The pillar is mounted on a circular base, which rotates so as to increase the steadiness of the base when the Microscope is inclined. The body slides in the grooved limb, and the fine-adjustment acts by a lever on the nose-piece. The mechanical stage has rectangular movements and also rotates. The original instrument, made for the Society in 1841, was exchanged in 1863 for a Ross binocular instrument. The present specimen was presented to the Society by Messrs. W. Watson and Sons in 1899.

Described and figured in Journ. R.M.S., 1899, p. 214.

Dr. EDWIN QUEKETT'S Microscope. 1844.

Type—Compound : Achromatic.

This instrument was designed and mainly constructed by Dr. Quekett, the founder of the Royal Microscopical Society, and was bequeathed by him to the Society. Whilst following James Smith's Microscope in general arrangement, this model is characterised by greater rigidity of the foot and pillar. The mechanical stage is made on A. Ross' pattern. Below the stage there is a focusing condenser.

Bequeathed to the Society by Dr. Quekett, who died June 28, 1847.

POWELL AND LEALAND. 1848.

Type—Compound : Achromatic.

This model is the first example in which the Microscope is hanging in a tripod, and also the first example in which the fine-adjustment moves the nose-piece by means of a lever within a bar. The mechanical stage has Turrell's rectangular movement, and possesses a focusing condenser. This type of Microscope appears to have been first made in 1843, but as in all the features mentioned it is being reproduced at the present day, it may be said to represent the modern instrument.

Described in Journ. R.M.S., 1901, p. 727. A duplicate of this instrument is described and figured in the Journ. R.M.S., 1898, p. 125.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Bacillus typhosus and B. coli on media containing Blood and Carbohydrates.†—E. P. Bernstein has observed the different behaviour of *B. typhosus* and *B. coli* when grown on agar containing 1 p.c. of various (16 varieties) carbohydrates, to each 15 c.cm. of which 1 c.cm. of sterilised ox blood has been added. On lactose blood agar typhoid colonies produced no hæmolysis; coli colonies did. On raffinose blood agar typhoid colonies are umbilicated with radiating lines; coli colonies do not show these peculiarities. On maltose blood agar typhoid colonies are almost black; coli colonies are dull white. On dextrose blood agar typhoid colonies caused a precipitation and were of a black colour; coli colonies caused hæmolysis and were white.

Special Nutrient Medium for Cholera Vibrio.‡—A. Dieudonné finds that alkaline blood agar is a favourable medium for the cholera vibrio and is antagonistic to the growth of *B. coli* and other intestinal organisms. The medium is prepared by mixing defibrinated blood with an equal amount of normal caustic potash and sterilising; 30 parts of this solution are then added to 70 parts of nutrient agar prepared in the usual way.

Cultivation of Bacillus Lepræ.§—M. T. Clegg describes attempts to grow the bacillus of leprosy in combination with an amœba and its symbiotic bacterium on a medium composed of agar 20, sodium chloride 0·3, beef-extract 0·3. A culture of amœbæ was obtained from a dysentery stool, and after a sufficient growth of the amœbæ had occurred to over-balance the symbiotic bacteria, leprosy bacilli were added by smearing the surface of the media with pulp from a leper's spleen. A short, plump, acid-fast bacillus developed, and from this subcultures were made. Successful results were obtained from two different cases of leprosy.

Fixation Methods and the Swelling of Alga Membranes.‖—F. Tobler makes an attempt at estimating the magnitude of the errors arising out of certain fixation methods and the amount of swelling of alga membranes. The materials used were the youngest portions of the red alga *Polysiphonia*. The fluids experimented with were:—(1) Iodine in sea-water. (2) Merkel's Solution (equal parts 1–400 platinum chloride and 1–400 chromic acid made up with water or sea-water). (3) Flemming's weak solution. (4) Formalin 40 p.c. diluted with water or sea-water. (5) Saturated solution of picric acid in 50 p.c. alcohol.

Demonstrating Karyokinesis in Stypocaulon Scoparium.¶—E. Escoyez fixed the material in Bonin's or Flemming's fluid; the latter

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, etc.; (6) Miscellaneous.

† Centralbl. Bakt., 1te Abt. Orig., l. (1909) p. 1. ‡ Tom. cit., p. 107.

§ Philippine Journ. Sci., iv. (1909) pp. 77–9.

‖ Zeitschr. wiss. Mikrosk., xxvi. (1909) pp. 51–8.

¶ La Cellule, xxv. (1909) pp. 181–201 (1 pl. and 30 figs.).

gave the better results. Under a dissecting Microscope pieces were cut off the ends of the filaments, and by means of a pipette were transferred to a small dialyser. When a sufficient number had been collected the alcohols were slowly upgraded and afterwards chloroform was added. When pure chloroform was reached, paraffin dissolved in chloroform was added, the oven temperature being 52° C. On arriving at pure paraffin the contents of the dialyser were poured into a paper boat placed on an iron blade heated sufficiently to keep the paraffin liquid. The pieces were then arranged parallel to one another by means of needles. As this procedure was always tedious and often unsuccessful, it was replaced by the following:—A larger dialyser was used and into it several hundreds of bits from the tips were thrown. The liquids were changed as before, but when they arrived in paraffin the boats were kept in the oven at 52° C. until the fragments had sunk to the bottom; the paraffin was then suddenly cooled. The sections were stained with iron-alum-hæmatoxylin with or without Congo red. The use of gentian-violet aided the differentiation. The greatest obstacle to success was the presence of diatoms which covered the surface of the filaments of *Stypocaulon*. As many as possible were removed by means of a brush.

Cultivating the Parasite of Oriental Sore.* — R. Row planted material from the sore in sterile sodium citrate solution (2 p.c.), and in human blood serum. Some of the cultures were left at laboratory temperature (25–28° C.), and some were incubated at 35° C. Those incubated at 35° C. and those planted in the sodium citrate solution did not show any growth, and soon disintegrated. In the blood serum cultures, kept at laboratory temperature, they increased in size. multiplied greatly, and finally became Herpetomonas-like flagellates. The author describes in detail the phases in the life-cycle, and gives reasons for discriminating between the parasite of oriental sore and that of kala-azar.

(2) Preparing Objects.

Demonstrating the Structure of Trypanosoma lewisi.† — E. A. Minchin, in an important paper on the structure of *Trypanosoma lewisi*, in relation to microscopical technique, gives a mass of information relative to manipulation and procedure from personal experience. He begins by showing how Trypanosomes may be effectively examined in hanging drops. To a hollow ground slide is cemented a ground-glass ring; the upper edge of the ring is painted with vaselin, and a drop or two of 4 p.c. osmic acid placed in the well. A cover-glass is then spread with a drop of blood and placed, film side downwards, on the ring. After a certain time the cover-glass is removed and placed, film side downwards, on a slide and insured against further evaporation by luting it with a mixture of beeswax and venetian turpentine. Such preparations are termed by the author "standard." In some of these standard preparations a small drop of ½ p.c. methyl-green in 1 p.c.

* Quart. Journ. Micr. Sci., liii. (1909) pp. 747–54 (1 pl.).
† Tom. cit., pp. pp. 755–808 (3 pls.).

acetic acid was placed on the slide after fixation in osmic acid. This tinges the nuclei of the Trypanosomes and does not affect their size. The method of testing the effects of the technique was carried out as follows:—The preparations were examined and drawn under exactly similar conditions, i.e. the Microscope and drawing arrangements were invariably the same; the illumination was an end-on flame concentrated by a collecting lens through a monochromatic screen on the mirror of the Microscope, and thence reflected through a centring achromatic condenser.

The author then goes on to point out why he gave up slide-smears for cover-glass preparations. The cover-slip is dropped down plump into the fixative, and the films or smears were always stained and mounted without being allowed to dry during any part of the process. The use of cover-slip films necessitates a modification in the mode of applying the osmic acid vapour. The requirements are a square block of hard paraffin and a ground-glass ring; the latter is heated and stuck on to one surface of the block, and a hollow is then dug out in the block. Osmic acid is placed in the cell thus made, and then the cover-glass with the blood-smear placed thereon. After sufficient exposure, the cover-slip is lifted off and dropped into alcohol, or some other fixative.

The fixatives used were osmic acid vapour followed by alcohol, mixtures containing osmic acid, and mixtures in which corrosive sublimate is the principal ingredient. The staining methods chiefly used were Giemsa, Heidenhain's iron-hæmatoxylin, and Twort's stain (a combination of neutral-red and light-green).

For numerous other details the original should be consulted.

Lendvai, J.—**Ein neuer Apparat zur Fixierung und Färbung der in wasser lebenden Mikrobien.** *Centralbl. Bakt.*, 2te Abt., xxiv. (1909) pp. 192–4 (2 figs.).

(3) Cutting, including Imbedding and Microtomes.

New Freezing and Cooling Arrangement for the Microtome.* R. Krause, after discussing the advantages and disadvantages of several cooling reagents, including liquid air, describes his experiences of solid carbonic acid gas, which he has found very satisfactory. To obtain carbonic acid in this condition the liquid form is allowed to issue slowly from the steel cylinder in which it is bought, and as this issue is under high pressure the sudden expansion lowers the temperature sufficiently to cause a deposit of carbonic acid snow. Small bags of the best silk velvet were found to be the best receptacles for this solid, which was afterwards transferred to a small Dewar flask, similar to those used for storage of liquid air. Such a flask is of double-walled glass, the inside of the walling being vacuous and silver plated; the whole arrangement is something like a beaker within a beaker (fig. 115), the two beakers being united at their rims. This freezing-chamber is inclosed in a brass cylindrical case of suitable size for the microtome-stage, and lined with non-conducting material (e.g. felt). The inner "beaker" receives a slightly smaller brass cylinder, the upper side of whose bottom has a vertical

* Zeitschr. wiss. Mikrosk., xxv. (1909) pp. 289–300 (4 figs.).

spiral spring, intended to press upward a little platform. The solid carbonic acid is accumulated on this platform, and the action of the spring forces it against the microtome-stage. An object on the stage therefore experiences a freezing effect. The outer and inner brass cylinders and microtome-stage are threaded and fit compactly together. The size of the whole, exclusive of the actual stage, is 45 mm. diam. and 85 mm. high. The author found that the cost of 1 hour's freezing was only one penny. The object to be frozen was moistened with a

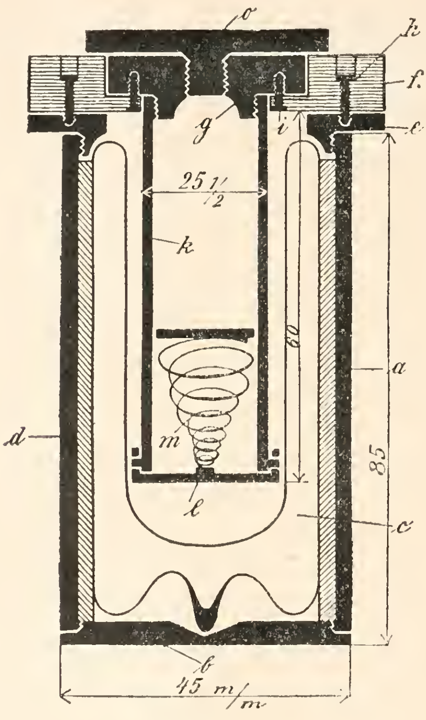

Fig. 115.

few drops of water, and the frost fastened it firmly to the stage. The author found he could cut a long series of faultless sections 5 μ thick from rather large objects, and he seems to have been well satisfied with his results. He also found that he could apply carbonic acid to the cooling and hardening of paraffin-imbedded objects.

Minot's Small Microtome.*—M. Wolff has designed a small form of the Minot-Zimmermann Microtome, Model I., and states that it

* Zeitschr. wiss. Mikrosk., xxvi. (1909) pp. 84–104 (5 figs.). See also a special pamphlet (No. 21) E. Zimmermann, Leipzig.

possesses the advantages of the well-known apparatus in a form adapted for private operators and for small institutions. The price, moreover, is reduced by more than one-half. Fig. 116 shows (for comparison), the

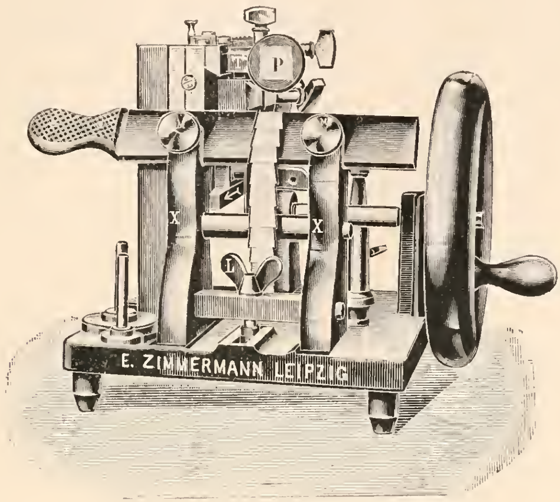

FIG. 116.

Model I., the ground-plate of which is 17 × 17 cm., the weight (net) 9·050 kg., maximum size of section 3·3 to 4·2 cm. × 5·5 cm., maxi-

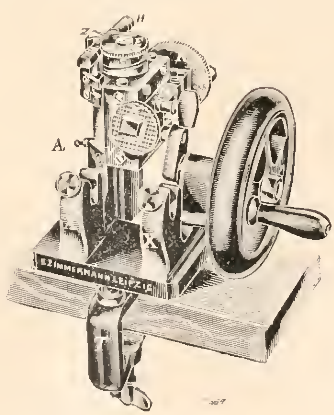

FIG. 117.

mum height of block 3·5 cm. Fig. 117 shows the new small model, which is described as having the following recommendations :—Automatic adjustment of section-thickness from 5 to 30 mikrons; maximum section-plane 30 × 25 mm.; maximum block-height 20 mm.; inclination of knife to section-plane regulated by clamping-screws; displacement of knife or object impossible; applicability for freezing (ethyl chloride); easy working by means of a well-balanced flywheel gear; compactness for travelling. No pains have been spared to secure precision of movement, and the machine may be operated quickly or slowly. The large clamp T fastens the instrument rigidly to the working table. The two strong pillars of the knife-holder X are cast on to the ground-plate, and the groovings for the knife are fitted with clamps for regulating the knife-inclination in order to adapt it as delicately as possible to the requirement of the object. The crank of the vertical slide V is balanced by the flywheel, and is operated in a very simple manner by the gearing; it can also be fixed in its highest position by a stop, so that coarse adjustments, supplementary paring of the block, treatment of the freezing chamber with ethyl chloride, etc., may be undertaken. The object-slide M is adapted on its upper half to excentric movement, and is actuated by a micrometer-screw of 0·5 mm. thread, and the progress forward of the preparation always follows upon the knife-cut. The ratchet H engages in the teeth of the cogged wheel R connected with the micrometer-screw and rotates it 1 to 6 teeth at each drop of the vertical slide according to the adjustment of the screw-head E; each tooth = 5 mikrons. The screw-head E is graduated into 1 to 6 parts, which correspond to the number of teeth to be moved. In addition to these automatic section arrangements it is possible, by putting the ratchet H out of gear, to cut freehand sections less than 2½ or greater than 30 mikrons, as desired. A well-defined straight line with millimetre divisions is used for the adjustment of blocks with parallel edges, and is inserted in the knife-holders conformably with the adjustment of the object in the object-holder. When the flywheel is rotated the block is lowered (or raised) just sufficiently to allow the upper (or lower) surface to come to the right level for cutting; a needle then traces a furrow in the block, which can then be trimmed off.

(4) Staining and Injecting.

Differential Staining of Spores.*—G. Proca and P. Danila find that the easiest way of staining killed spores is to treat the film with boiling decinormal solution of caustic soda for a few minutes and then to stain with their methylen-blue-fuchsin solution.

Twort's Neutral-red and Light-green Stain.†—This reagent is prepared by making up half-saturated solutions of neutral-red and of Grübler's Licht-grün in distilled water. The neutral-red solution is placed in a large open vessel, and sufficient light-green solution is added. A precipitate forms, and this is allowed to sediment. The supernatant fluid is decanted off, and then the precipitate is rinsed in distilled water

* C.R. Soc. Biol. Paris, lxvii. (1909) pp. 307–9.
† Quart. Journ. Micr. Sci., liii. (1909) pp. 755–808 (3 pls.).

and dried at 37° C. The dry pigment is fairly soluble in methyl-alcohol, and more so if 5 p.c. glycerin be added. To make up the stain for use it is advisable to pound up 0·25 grm. with some sharp clean sand: this prevents the stain going into a sticky mass when the alcohol is added. Then dissolve the dry residue in methyl-alcohol containing 5 p.c. glycerin.

Stain for 5 minutes or more in a solution made with 2 parts stock solution and 1 part distilled water. Rinse in distilled water. Fix for ½ to 1 minute in Unna's glycerin-ether mixture 2 p.c. in H_2O. Rinse in distilled water. Differentiate and dehydrate in absolute alcohol. Any precipitate is easily removed by means of methyl-alcohol, or by equal parts of absolute alcohol and xylol. Then xylol and balsam. This stain does not appear to act well after osmic acid or its mixtures, but good results are obtainable from sublimate and its mixtures.

Savini, E., & Th. Savini-Castano—**Zur Technik der Elastika und Bindegewebs-färbung.** *Zeitschr. wiss. Mikrosk.*, xxv. (1909) pp. 29–47.

Sommerhoff, E. O.—**Die Färbung der Pikrinsäure auf Seide.**
A phenomenon of *Osmosis*, in which the sheath of the silk filament acts as an animal membrane; chromaturgical considerations in reference to the staining of bacteria. *Tom. cit.*, pp. 48–51.

Cavazza, L. E.—**Studi microchemici e fisiologici sui Tannini.** *Tom. cit.*, pp. 59–64.

(5) Mounting, including Slides, Preservative Fluids, etc.

Examining and Mounting the Digestive System of Schizopoda.*—C. Gelderd fixed the material in the following fluid:—Formalin, 40 p.c., 5 c.cm.; alcohol, 94 p.c., 30 c.cm., H_2O 100 c.cm.; or in Gilson's fixative: Nitrate of copper, 200 gr.; formalin, 500 c.cm.; sea-water, 200 c.cm.: 7 c.cm. were used with 100 c.cm. of sea-water. The sections were stained and mounted in the usual way, or with Gilson's euparal, which has the advantage of being able to be used after dehydrating in 70 p.c. alcohol.†

Isobutyl-alcohol was very useful when mounting in euparal, as it is less volatile and absorbs water less rapidly than ethyl-alcohol, and delicate objects could be manipulated by its aid without danger of contracting the tissues. The procedure was as follows:—Dehydrate with ethyl-alcohol at 70 p.c.; wash in isobutyl-alcohol; mount immediately in euparal.

(6) Miscellaneous.

Metal Filter.‡—E. Gobbi describes a filter, made of nickel, the pores of which are fine enough to hold back ultra-microscopic particles. Such an apparatus should be invaluable in bacteriological laboratories.

Don, J.—**The Filtration and Purification of Water for Public Supply.** *Proc. Inst. Mech. Eng.*, 1909, pp. 1–209 (3 pls.)

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* La Cellule, xxv. (1909) pp. 7–68 (4 pls.).
† See this Journal, 1906, p. 501.
‡ Comptes Rendus, cxlviii. (1909) pp. 1126–8.

Metallography, etc.

Structure of Coinage Bronze.*—F. Giolitti and E. Pannain have studied the microstructure of Italian coinage bronze, containing 95·8 p.c. copper. 3·82 p.c. tin, and 0·38 p.c. impurities. The polished sections were repeatedly etched with hot nitric acid 0·24 p.c., and were gently repolished with chromium oxide after each etching. The alloy as cast was found to consist of the solid solutions α and β, though a bronze of this composition should consist entirely of α. The presence of β-crystals is due to the speed of cooling, which is too great to permit of the establishment of equilibrium between the first α-crystals and the liquid. The concentration of the liquid in tin thus increases beyond the theoretical value, and the β-crystals, rich in tin, result. The β-crystals were not removed by heat treatment. The authors investigated the effect of mechanical work on the alloy.

Arsenic and Antimony in Copper.†—A. H. Hiorns and S. Lamb have studied the influence of small quantities of arsenic and antimony on copper. Thirteen alloys were prepared containing 0·05 to 2·9 p.c. arsenic, and thirteen alloys containing 0·1 to 3·5 p.c. antimony. Various physical tests were carried out, and sections for microscopic examination were cut transversely from both quickly and slowly cooled ingots. Both series of alloys were found to consist of dark soft crystals, surrounded by a lighter and harder constituent which increased in quantity as the proportion of the foreign element was greater. In the slowly cooled alloys small quantities of bodies, which appeared to be the chemical compounds Cu_3As and Cu_3Sb, were noted.

Gold-tellurium Alloys.‡—H. Pélabon has determined the solidification temperature curve of the gold-tellurium system. A eutectic containing 16·5 p.c. gold solidifies at 415° C. A maximum (472° C.) at 41 to 45 p.c. gold indicates the existence of a definite compound, which appears to correspond to the mineral calaverite Au_2Te_4. From 45 to 56 p.c. gold the curve falls to 452° C., the melting-point of tellurium. All the alloys containing more than 56 p.c. gold solidify at 452° C., but at higher temperatures are increasingly pasty as the content of gold is greater. No indication of the existence of Au_2Te was obtained.

Cobalt-tin Alloys.§—S. F. Zemczuzny and S. W. Belynsky give an equilibrium diagram obtained by thermal methods and confirmed by microscopic examination of the alloys. Two compounds, Co_2Sn and CoSn, and two eutectics were found. CoSn is non-magnetic, as are also all the alloys with less cobalt than this compound.

Boiling-points of Metals.‖—H. C. Greenwood has employed a vertical carbon tube resistance furnace; in it was suspended a long graphite

* Atti R. Accad. Lincei, xvii. (1908) pp. 668–70, through Journ. Chem. Soc., xcvi. (1909) pp. 144–5.
† Journ. Soc. Chem. Ind., xxviii. (1909) pp. 451–7 (8 figs.).
‡ Comptes Rendus, cxlviii. (1909) pp. 1176–7.
§ Zeitschr. Anorg. Chem., lix. (1908) pp. 364–70 (7 figs.).
‖ Proc. Roy. Soc., Series A, lxxxii. (1909) pp 396–408 (2 figs.)

crucible containing the metal the boiling-point of which was to be determined. The temperature of the outer walls of the crucible was taken by a Wanner optical pyrometer. The surface of the metal was observed from above; the commencement of boiling could easily be noted. For metals which combine with carbon, the graphite crucibles were lined with magnesia. The following temperatures are given as approximate boiling-points :—

Aluminium	1800° C.	Copper ..	2310° C.	Manganese	1900° C.
Antimony	1440	Iron ..	2450	Silver ..	1955
Bismuth ..	1420	Lead ..	1525	Tin ..	2270
Chromium	2200	Magnesium	1120		

Structure of Steels at High Temperatures.* — A. Baykoff first confirmed Maurer's results by obtaining homogeneous austenite from a steel containing 1·79 p.c. carbon, 2·14 p.c. manganese, 0·89 p.c. silicon, quenched from 1110° C. Pure austenite has been defined by H. le Chatelier as a solution of carbon in γ-iron, stable between the solidification temperature and a temperature varying from 700–1200° C., according to carbon content. The purest austenite hitherto obtained, homogeneous at ordinary temperatures, is Maurer's, containing about 2 p.c. manganese. In order to ascertain the structure of pure austenite in its stable range, the author etched previously polished sections of five steels containing 0·12–1·94 p.c. carbon, some being almost free from other elements, at 1120° C. The polished sections were placed in the porcelain tube of an electric resistance furnace. Hydrogen was passed through for several hours, and the temperature was then raised to the required degree. Hydrochloric acid was then introduced for several seconds, the current of hydrogen continued for 2 to 3 hours, and the furnace allowed to cool. The steels, etched in this way at 1120° C., all showed the polyhedric structure characteristic of austenite. Twinning was noted in several cases. Etching at 870° C. in a similar way failed to reveal a martensite structure. Martensite does not appear to be stable at any temperature, but to be a structure developed only by quenching.

Structure of Hardened Steel.† — W. J. Kurbatow and M. M. Matwejew find that the best method of producing austenite is to quench steel of 1·8–2·2 p.c. carbon, heated nearly to melting, in mercury at 130° C. The lance-shaped crystals occurring between the austenite crystals, are troosto-sorbite. The equilibrium austenite $\rightleftarrows$ sorbite proceeds from right to left between 90° and 150° C., and above 1000° C. Between 150° and 750° C. the equilibrium proceeds from left to right, most rapidly at 250° C. All the constituents of steel are crystalline. Austenite is probably a carbide of iron Fe_7C (?) (Fe_6C – $Fe_{10}C$). Troostite and sorbite are solutions of carbon in iron, α or β. The austenite is unchanged after heating at 65–85° C. for several months. At 118° C. recrystallisation is evident in a few days. At 180° C. austenite changes to troostite. The old scheme of transformation austenite-martensite-troostite-sorbite-pearlite is inaccurate.

* Rev. de Métallurgie, vi. (1909) pp. 829–34 (10 figs.).

† Metallurgie, v. (1908) pp. 721–8 (8 figs.).

Hardening and Tempering of Iron and Steel.*—E. Maurer gives an account, previously published elsewhere, of his work on this subject, and adds lengthy and important conclusions drawn by F. Osmond. By quenching from a sufficiently high temperature γ-iron may be produced in hypo-eutectic as well as in hyper-eutectic steel. Cold working may also produce a small proportion of γ-iron. No causal relation exists between carbon (as hardening carbon), and hardness of steel. The increase of electrical resistance, due to quenching, appears to be a measurement of the amount of carbon which has gone into solution, and the curve connecting electrical resistance, a function of the hardening carbon, with temperature of re-heating of quenched steels, does not follow the hardness curve. Carbon appears to remain in solution because of the γ-iron present in martensite. The letting down of quenched steels proceeds in four distinct stages :—(1) from the ordinary temperature to 150° C. ; (2) 150–300° C. ; (3) 300–450° C. ; (4) 450° C. to the recalescence point. For the complete theory of hardening, founded by Osmond on the facts observed by Maurer and others, the original should be consulted.

Electrolytic Iron.†—A. Müller has obtained a considerable quantity of electrolytic iron, containing 0·03–0·05 p.c. fixed impurities and small amounts of hydrogen and nitrogen, and has studied its thermal and other properties. Microscopic examination showed that the iron was deposited in a laminated form and contained numerous blowholes and mechanical inclusions. With high magnification, systems of lines radiating from points were observed. This star-like structure appeared to be related to the crystalline structure of the iron. Several fusions of the iron, in a magnesia crucible, heated in a vacuum electric resistance furnace, were required to drive off hydrogen and nitrogen. The critical points on heating were found at 917° C. and 765–774° C., and on cooling at 894° C. and 766–759° C. Other critical points were found in hydrogen-containing samples, the most marked being at 1210° C.

Iron-phosphorus System.‡—E. Gercke gives an equilibrium diagram, obtained by thermal and microscopical methods, for the range 0 to 22 p.c. phosphorus. Phosphorus is completely soluble in solid iron up to 1·7 p.c. From 1·7 to 10·2 p.c. a eutectic line is found at 980° C. The eutectic solidification-point may, however, be lowered to 880° C. by supercooling. The eutectic iron-phosphide of iron contains 10·2 p.c. phosphorus.

Iron-phosphorus-carbon System.§—P. Goerens and W. Dobbelstein conclude, from a study of sixteen alloys of different carbon and phosphorus content, that, as regards phenomena of solidification, this system may be considered as a ternary system, the components of which are iron, carbide of iron, Fe_3C, and phosphide of iron, Fe_3P. The ternary eutectic solidifies at 953° C., and has the composition C 1·96 P 6·89 Fe 91·15 p.c. The equilibrium diagram is given. Metallographic methods were found

* Metallurgie, vi. (1909) pp. 33–52 (64 figs.). See also Rev. de Métallurgie, v. (1908) pp. 711–50; and this Journal, 1908 p. 784.
† Tom. cit., pp. 145–60 (15 figs.).
‡ Op. cit., v. (1908) pp. 604–9 (14 figs.). § Tom. cit., pp. 561–6 (14 figs.)

to give results more definite than those obtained from cooling curves. In alloys of nearly eutectic composition the separation of primary crystals could hardly be detected by thermal methods, whilst the crystals were clearly distinguished microscopically. The structure of most of the sections was developed by etching and heat-tinting, followed by light repolishing.

Alloys of Iron with Arsenic and Bismuth.*—C. F. Burgess and J. Aston have studied these alloys, prepared, free from carbon, from electrolytic iron. The effect of arsenic in acid pickling baths in retarding the rate of attack of the acid upon steel had suggested that arsenic in steel might render it less readily corrodible. The author's experiments did not bear out this notion, the iron-arsenic alloys resisting corrosion little better than iron and steel containing no arsenic. The addition of arsenic to iron improves its magnetic properties, but more than 0·25 p.c. is detrimental in its physical effects.

Some Iron-silicon-carbon Alloys.†—W. Gontermann has investigated this ternary system within the limits Fe-Fe_3C-$FeSi$ by the method of thermal analysis, and has also revised the equilibrium diagrams for the iron-carbon and iron-silicon systems. It is suggested that the formation of "kish" in the high-carbon alloys of the iron-carbon system may be explained by the decomposition of cementite on melting into two immiscible liquids, one considerably richer in carbon than the other. The equilibrium diagram of the ternary system, given and explained by the author, does not permit of a brief summary. Typical photomicrographs are given.

Special Steels.‡—L. Guillet indicates the directions in which progress has been made in the manufacture of alloy steels since the Brussels Congress. While the polyhedric steels are losing in importance, pearlitic special steels are receiving wider application.§ In their manufacture the objects aimed at are (1) increase in mechanical strength; (2) simplification of thermal treatment; (3) for parts exposed to friction, increase in resistance to abrasion.

Heat-treatment of Spring Steel.‖—L. H. Fry has determined the transverse elastic limit and modulus of elasticity of steel containing 1·01 p.c. carbon, 0·38 p.c. manganese, heat-treated in various ways. The modulus of elasticity was found to be practically constant and independent of the heat-treatment, its value being $29 - 30 \times 10^6$ lb. per square inch.

"Slag Enclosures" in Steel.¶—W. Rosenhain calls attention to the possible effect upon the strength of steel of those non-metallic bodies which may be designated as "slag enclosures." A number of photomicrographs of typical forms of these enclosures are given. The

* Electrochem. and Met. Ind., vii. (1909) p. 276.
† Zeitschr. Anorg. Chem., lix. (1908) pp. 373-413 (15 figs.).
‡ Proc. Int. Assoc. for Testing Materials No. 5 (1909) 7 pp.
§ See this Journal, 1909, p. 538.
‖ Proc. Int. Assoc. for Testing Materials, No. 5 (1909) 9 pp. (2 figs.).
¶ Op. cit., No. 10, (1909) 10 pp. (7 figs.).

distribution of sulphide of manganese may be ascertained by taking a "sulphur print." Baumann's method is to apply a sheet of photographic bromide paper, moistened with dilute sulphuric acid, to the steel. The sources of sulphide and silicate of manganese have been held to be the sulphur, manganese, and silicon present in the steel, and the oxygen of the atmosphere, but the author considers that these enclosures may also arise from the inclusion within the steel of furnace slag, or of siliceous matter picked up by the molten metal in its passage from furnace to ingot mould.

Sulphur as a Cause of Corrosion in Steel.*—G. N. Huntly has investigated the pitting of a steam boiler. Blisters on the interior surface of the boiler were found to contain a solution of ferrous sulphate, together with free sulphuric acid, and a pit was forming in the centre of each blister. The only possible source of the free acid appeared to be the manganese sulphide in the steel.

Nickel Steel Injured by Over-heating.†—E. Heyn and O. Bauer have investigated the cause of the cracking in forging of two pieces of steel containing 5·49 p.c. nickel and 0·09 p.c. carbon. Sections polished and etched with copper-ammonium chloride showed a very coarse structure, similar to that of a casting, but no segregation or slag inclusions. The steel became fine-grained when heated at 900° C. for one hour. Forging tests made on pieces heated at different temperatures, for different lengths of time, showed that the steel cracked on forging when heated above a certain temperature. This limiting temperature was found to depend both on the size of the piece and the duration of heating.

Cementation.‡—In the first and second of these articles F. Giolitti points out the disadvantages involved in the rapid fall of carbon content from surface to interior of steels carburised in the usual way. A more uniform percentage of carbon in the carburised layer may be obtained by employing, as cementation agent, a mixture of carbon monoxide and carbon dioxide, or a hydrocarbon. The composition of the gas mixture is adjusted to give the desired carbon content in the steel.

The third article, by F. Giolitti and F. Carnevali, deals with the lower limit of the temperature interval within which cementation may be effected. The discrepancy between the author's previous statement that 700 C. is the lower limit, and Charpy's results, is explained by the observation that at lower temperatures carbon monoxide acts upon iron, forming an adherent layer, probably a carbide of iron. This is not cementation in the sense understood by the authors.

Malleable Cast Iron.§—F. Giolitti, F. Carnevali, and G. Gherardi have studied the conversion of cast iron containing 2·9 to 3·6 p.c.

* Journ. Soc. Chem. Ind., xxviii. (1909) pp. 339–40.

† Stahl und Eisen, xxix. (1909) pp. 632–5 (13 figs.).

‡ Rend. Soc. Chim. di Roma, vi. (1908) pp. 337–41, 354–8, 359–63, through Journ. Soc. Chem. Ind., xxviii. (1909) p. 205.

§ Rend. Soc. Chim. di Roma, vi. (1908) pp. 388–93; Atti R. Accad. Lincei, xvii. (1908) pp. 662–7, 748–54, through Journ. Soc. Chem. Ind., xxviii. (1909) pp. 205, 215.

carbon, 0·1 to 0·2 p.c. silicon, and 0·03 to 0·18 p.c. manganese, into malleable cast iron by heating in oxide of iron at about 1000° C. In samples withdrawn after different periods, estimations of carbon at different depths and microscopic examination showed that the carbon content increased gradually with the depth, passing through a pearlite zone of constant composition. The chief factor in decarburisation is the diffusion of oxidising gases from the iron oxide into the interior, but the diffusion of carbon from the interior outwards also plays a part. The statement of Wüst,* that the formation of temper-carbon from cementite is a necessary preliminary to decarburisation is disputed.

Decarburisation of Iron-carbon Alloys.†—W. H. Hatfield disagrees with Wüst's view that in the decarburisation of white iron the carbon must be precipitated as temper-carbon before it is eliminated. Pieces of cemented Swedish bar-iron containing 1·64 p.c. carbon, all combined, were packed (1) in charcoal, (2) in sand, (3) in iron ore, and heated slowly. The temperature was maintained at 890° C. for 24 hours, then raised to 960° C., where it was kept for 48 hours. The temperature then fell very slowly. In (1) the carbon content was unchanged, in (2) it had fallen to 0·75 p.c., in (3) to 0·15 p.c. No temper-carbon could be found in any of the three samples, either by chemical analysis or microscopically. Carbon may therefore be eliminated without previous formation of temper-carbon. The examination of white iron at different stages in its conversion to malleable iron fully confirmed this view.

Progress in Metallography.‡—E. Heyn reviews the output of research in metallography and related subjects, from the Brussels Congress of 1906 up to the beginning of 1909. A comprehensive list of papers published is given, with valuable explanatory and critical comments. The papers are classified as dealing with :—1. Researches for establishing the chemistry of intermetallic compounds, chiefly by the determination of equilibrium diagrams of systems of alloys, without regard to their practical utility. 2. The iron-carbon system. 3. Iron and manganese alloys, including special steels. 4. Alloys of industrially useful metals other than iron. 5. Metallographical investigation of phenomena in the manufacture of metals other than iron. Friedrich's studies relating to the formation of matte and speiss are examples. 6. The phase theory, physico-chemical methods, crystallography, etc. 7. Accessories for metallographical work. 8. Industrial application of metallography.

Metallographic Notes.§—K. Friedrich ranges over a variety of subjects. The employment of ultra-violet light for photomicrography does not offer advantages commensurate with the increased difficulties of manipulation. Some questions arising in the study of the nickel-cobalt-arsenic alloys are dealt with. No evidence was found for the existence of a compound Ni_2As.

* See this Journal, 1908, p. 258.
† Journ. Iron and Steel Inst., lxxix. (1909) pp. 242–60 (7 figs.).
‡ Proc. Int. Assoc. for Testing Materials, No. 5 (1909), 20 pp. Report presented to the 5th Congress, Copenhagen, September, 1909.
§ Metallurgie, v. (1908) pp. 593–604 (16 figs.).

Industrial Application of the Microscope.*—W. H. Davis describes the method of employing the Microscope in controlling the roasting of a sulpho-telluride gold ore, chemical analysis failing to give sufficiently definite information as to the relation between the condition of the gold and the roasting temperature.

Illumination in High-power Photomicrography.† — C. Benedicks points out that published metallographical photomicrographs at 1000 or more diameters, with a few exceptions, leave much to be desired in sharpness of definition. This appears to be due to the neglect of an important factor. The Beck illuminator, a thin glass plate set at an angle of 45° in the Microscope tube, has, on account of certain disadvantages, been replaced to a large extent by the Zeiss or Nachet prism. Such totally-reflecting prisms cut off one-half of the light rays proceeding from the objective, and the author proves that this is equivalent to a large reduction in numerical aperture. Tests of a Zeiss 2 mm. apochromat N.A. = 1·30, with and without a piece of black paper fixed above one half of the objective, were made on various test-objects viewed by transmitted light. The resolving power was greatly reduced by the presence of the paper. Photomicrographs at 1200 diam. are given of the same field of lamellar pearlite illuminated (1) by a reflecting prism; (2) by a cover-glass at 45°; (3) as (2), but with one-half of the cone of light cut off by a diaphragm placed above the glass disk: (2) showed much sharper definition than either of the other two photomicrographs. The faults of the Beck illuminator are shown to be not serious: it is accordingly to be preferred to the prism for high-power work.

Autographic Registration of Cooling Curves.‡ — E. F. Northrup describes a sensitive autographic recorder to be used with a resistance pyrometer. The author discusses the various methods of taking cooling curves, and concludes that the direct time-temperature curve gives all the information required.

Measurement of Hardness.—P. Ludwik § submits the official report to the Copenhagen Congress. Only those methods which have been extensively introduced into technical practice are dealt with—the ball-pressure and cognate cone-pressure tests.

A. Martens and E. Heyn ‖ recommend the measurement of depth of impression rather than diameter in the ball-hardness test, and describe a machine for impressing the ball into the test-piece and measuring the depth with great accuracy.

A. Gessner ¶ has investigated the relation between hardness (as measured by the cone-pressure test) and tensile strength of permanent-way materials.

H. Moore** has determined the limiting conditions (minimum thickness and diameter of test-piece permissible) for the ball-pressure hardness

* Metallurgie, v. (1908) p. 734 (4 figs.).
† Op. cit., vi. (1909) pp. 320–3 (3 figs.).
‡ Electrochem. and Met. Ind., vii. (1909) pp. 273–4 (1 fig.).
§ Proc. Int. Assoc. for Testing Materials, No. 6 (1909) 12 pp. (5 figs.).
‖ Tom. cit., 10 pp. (6 figs.).
¶ Tom. cit., 2 pp.
** Op. cit., No. 9, 11 pp. (1 fig.).

test. It is suggested that mean pressure per unit area be taken to represent the hardness of the material tested, when the diameter of impression is one-half the diameter of ball. Meyer's formula for expressing the relation between load and diameter of impression, $P = ad^n$, is confirmed; the value of n almost invariably lies between 2 and 2·5. The author points out that $n - 2$ may be taken to represent capacity for hardening by cold work.

T. Turner * discusses the definition of hardness, and compares, as four typical methods for determining that property, the Turner sclerometer, the Shore scleroscope, the Brinell test, and the Keep drill test.

Internal Friction in Loaded Materials.† — G. H. Gulliver draws the following conclusions from experimental work on the modes of deformation of steel and other metals under stress, and from theoretical considerations. The general directions of internal sliding in a body under load, as revealed by the lines of Lüders and by fractured surfaces, are consistent with the action of a frictional resistance between the particles of the body, differing little from that of ordinary external frictional resistance. Determinations of strength show variations far too great to allow of even an approximate calculation of the value of the coefficient of internal friction.

Influence of Time and Temperature on Impact Tests. ‡ — A. le Chatelier points out that rate of loading, in tensile tests at temperatures above 100° C., has an enormous influence on the results. Thus a mild steel wire, at 170° C., gave a tensile strength of 45 kg. per sq. mm., and elongation 10 p.c. when the test occupied 20 minutes, while when the wire was broken in 2 seconds the tensile strength was 27 kg. and elongation 28 p.c. It is probable that variations in speed in shock tests will have an equally great influence. This being so, the results given by Guillet and Révillon § will hold only for the speed of testing used: probably at lower speeds the temperature of maximum brittleness would be lower. The author summarises the results of his experimental investigations on the effect of time and temperature on the mechanical properties of steel.

L. Guillet and L. Révillon ‖ have made shock tests at temperatures from 20–650° C. on a 0·35 p.c. carbon steel, causing the striking velocity to vary through a considerable range. No effect due to variation in speed of testing could be detected, the temperature of maximum brittleness remaining constant at 460–480° C. Further results of shock tests at various temperatures are given for a number of special steels, selected as possessing typical microscopic structures (pearlitic, martensitic, polyhedric, etc.).

"Damping" in the Testing of Iron.¶—A. Guillet suggests a new method of testing metals. A metallic rod, fixed at one end, deformed

* Journ. Iron and Steel Inst., lxxix. (1909) pp. 426–43 (1 fig.).
† Proc. Int. Assoc. for Testing Materials, No. 7 (1909) 7 pp.
‡ Rev. de Métallurgie, vi. (1909) pp. 914–17.
§ See this Journal, 1909, p. 263.
‖ Tom. cit., pp. 918–24 (2 figs.).
¶ Rev. de Métallurgie, vi. (1909) pp. 885–7.

elastically by bending and then suddenly let go, resumes its position of equilibrium after a series of oscillations, more or less "damped." As the "damping" (amortissement) depends on the internal structure, an investigation of the rate at which the vibrations die away should give useful information. It was found that the damping of a specimen of soft iron was three times as rapid as that of a mild steel. A method of measuring the damping is described.

H. le Chatelier* considers that the method may be valuable, as measuring a new elementary property of metals, which is possibly of great importance in their practical applications. The desirability of fully investigating this method of testing is insisted upon, and an outline programme of research is given.

Friction in Compression Tests.†—G. H. Gulliver has studied the effect of the friction of the crushing plates upon the yield-point of short compression specimens. With plates harder than the material under test, the end friction causes an increase in the apparent yield-point. When the crushing plates are softer than the material under test, the apparent strength of the specimen is diminished. Calculated numerical values for both effects are given.

Elastic Limits of Iron and Steel under Cyclical Variations of Stress.‡—L. Bairstow finds that iron or steel is capable of adjusting itself to variations of stress, cyclically applied, after a sufficient number of repetitions. When the adjustment is complete the specimen is found to have become perfectly elastic throughout the whole cycle, and fatigue does not occur. An extension of length of specimen occurs during this adjustment. The greater the extension, the greater is the amount by which the elastic limits are raised.

GULLIVER, G. H.—**Effect of Internal Friction in Cases of Compound Stress.** *Proc. Roy. Soc. Edin.*, xxix. (1909) pp. 427–31.

HOWARD, J. E.—**Endurance of Steels to Repeated Alternate Stresses.** [In tests made on a machine in which the rotating test bar is submitted to a bending stress, fracture resulted at stresses much below the elastic limit. The existence of internal stresses is suggested as an explanation.] *Proc. Int. Assoc. for Testing Materials*, No. 5 (1909) 7 pp. (4 figs.).

* Rev. de Métallurgie, vi. (1909) pp. 887–9.
† Proc. Roy. Soc. Edin., xxix. (1909) pp. 432–44 (6 figs.).
‡ Proc. Roy. Soc., Series A, lxxxii. (1909) pp. 483–5. (Abstract.)

JOURNAL

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DECEMBER, 1909.

TRANSACTIONS OF THE SOCIETY.

XVI.—*On the Recent and Fossil Foraminifera of the Shore-sands of Selsey Bill, Sussex.*—IV.

By Edward Heron-Allen, F.L.S., F.R.M.S., and Arthur Earland.

(*Read Nov.* 17, 1909.)

Plates XX., XXI.

Family IX. ROTALIDÆ.

Sub-family 2. **Rotalinae.**

Cycloloculina Heron-Allen and Earland.

172. *Cycloloculina annulata* Heron-Allen and Earland.

173. *Cycloloculina polygyra* Heron-Allen and Earland.

This generic form, with its two species, has been fully described in the first paper of this series.* At the date of publication of that paper, we had failed to find the genus represented in any gathering north-west of Medmerry Farm, and its notable abundance in a small gathering made at high-water mark just south-east of Medmerry Farm in May 1909 seemed to point to some bed of Eocene clay, exposed just below low-water mark at that place, as its locality of origin, regard being had to the strong set of tides from that point to the extreme end of Selsey Bill, east of the Marine Hotel. It has, however, been found since then in considerable quantity in an extended shore-gathering made between

* See this Journal, 1908, pp. 529–43.

West Wittering and Earnley, some miles north-west of the north-west limit of our researches up to that date, and again in a remarkably rich gathering made recently at the west end of the "House-pond" Beds, just south-east of the sluices, where one of the principal exposures of Bracklesham Bay fossils occurs between tide-marks. It would, therefore, appear to be present wherever any Foraminifera are to be found derived from the Eocene clays of the Bracklesham Beds.

In making a more careful and detailed study of the specimens originally selected from the main gathering referred to in our first paper, we have found the first specimen picked out, which we then referred to the species *Planorbulina costellata* of Terquem. This specimen exhibits certain noteworthy peculiarities, to wit, the large (megalospheric) size of the primordial chamber, which is followed by a curved chamberlet about three times the length, and equal in breadth to the primordial chamber. The Pavonine stage is represented by the next three chambers, all of which are equal in diameter to the primordial chamber. The fifth chamber is completely annular, retaining the same breadth. From this point the annular chambers show a very slight increase in diameter. Three such annular chambers are visible in the specimen under consideration, which is quite flat, the septal lines being distinctly marked, although flush with the surface. From this point the character of the shell changes entirely: the annuli are but very slightly defined, and the shell increases considerably in thickness. The surface of these outer rings is strongly crenulated, as in fig. 5 of the original plate, and this gives a very decided, but illusory suggestion of a division of the annular chamber into chamberlets. The specimen is somewhat broken round the edges, but there were probably at least three annuli presenting this crenulated surface. It is possible that further specimens, should we be so fortunate as to discover them, may necessitate the separation of this form from *C. polygyra*.

Planorbulina d'Orbigny.

174. *Planorbulina mediterranensis* d'Orbigny.

Planorbulina mediterranensis (d'Orbigny) 1826, Ann. Sci. Nat., vol. vii. p. 280, No. 2, pl. xiv. figs. 4–6: Modèle No. 79.
Planorbulina vulgaris (d'Orbigny) Williamson, 1858, Recent Foram. Gt. Britain, p. 57, pl. 5, figs. 119, 120.
Planorbulina mediterranensis (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 656, pl. xcii. figs. 1–3.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

Recent and fossil, the latter being much larger than the former, which are of the regular type commonly found in British gatherings.

175. *Planorbulina larvata* Parker and Jones.

Planorbulina vulgaris var. *larvata* Parker and Jones, 1860, Ann. and Mag. Nat. Hist., ser 3, vol. v. p. 294.
Planorbulina larvata Id., 1865 Phil. Trans, vol. clv. p. 379, pl. xix. fig. 3 *a*, *b*.
Ditto. (Parker and Jones) Brady, 1884, Foram. 'Challenger,' p. 658, pl. xcii. fig. 5, 6.
Ditto. (Parker and Jones) Guppy, 1909, Trans. Canadian Institute, vol. viii. p. 387.

Several specimens, in various stages of development. All fossils; some pyritised, and evidently from a clay, the others from a shell-sand: the latter are not so well preserved as the former. Brady's specimens were recent, from tropical shallow waters, and, so far as we are aware, it has not previously been recorded as fossil except by Mr. R. J. Lechmere Guppy (*suprâ*), who records it as abundant in the shallow-water Miocene beds of Trinidad, West Indies.

Truncatulina d'Orbigny.

176. *Truncatulina lobatula* Walker and Jacob sp.

Nautilus lobatulus Walker and Jacob, 1798, Adam's Essays, Kanmacher's edition, p. 642, pl. xiv. fig. 36
Truncatulina lobatula (Walker and Jacob) Williamson, 1858, Recent Foram. Gt. Britain, p. 59, pl. v. figs. 121-3.
Ditto. (Walker and Jacob) Brady, 1884, Foram. 'Challenger,' p. 660, pl. xcii. fig. 10; pl. xciii. figs. 1, 4, 5.
Ditto. (Walker and Jacob) Brady, 1887, Synopsis British Recent Foraminifera.

Abundant, both fossil and recent. Typical, and presenting every aspect of this very variable species. Among the fossils are some of a very regular depressed type, which renders them almost indistinguishable from the genus *Discorbina*.

177. *Truncatulina variabilis* d'Orbigny.

Truncatulina variabilis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 279, No. 8.
Ditto. (d'Orbigny) Terquem, 1878, Mém. Soc. géol. France, sér. 3, vol. i. Mém. iii. p. 20, pl. i. fig. 18-25.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 661, pl. xcii. figs 6, 7.
Ditto. (d'Orbigny) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 225.
Ditto. (d'Orbigny) Sidebottom, 1909, Mem. and Proc. Manchester Lit. and Phil. Soc., vol. liii. pt. iii. No 21, p. 2, pl. i. figs. 5, 6, pl. ii. figs. 1-3.

A great number of specimens, illustrating fairly well the vagaries of *T. lobatula*, which have been separated under this name. The majority are fossils, but many recent specimens occur. Recent specimens are recorded by Earland from Bognor—rare. Sidebottom (*suprâ*) figures a remarkable series of specimens from Delos.

178. *Truncatulina tenuimargo* Brady. (Plate XX. fig. 2, *a*, *b*.)

Truncatulina tenuimargo Brady, 1884, Foram. 'Challenger,' p. 662, pl. xciii. figs. 2, 3.

The specimens are sufficiently typical to claim place in Brady's species. The line of demarcation between this and *T. lobatula*, however, entirely depends on the development of the keel, and the extent to which this keel is developed probably depends upon the nature of the surface to which the specimen was adherent. We have observed that whereas *T. lobatula* is extremely abundant in the recent stage attached to polyzoa and seaweeds, such specimens rarely or never develop any trace of the keel, whilst individuals which have grown in the attached form on smooth shells and stones have a marked tendency in this direction.

179. *Truncatulina wuellerstorfi* Schwager sp.

Anomalina wuellerstorfi Schwager, 1866, Novara. Exped. geol. Theil, vol. ii. p. 258, pl. vii. figs. 105, 107.

Truncatulina wuellerstorfi (Schwager) Brady, 1884, Foram. 'Challenger,' p. 662, pl. xciii. figs. 8, 9.

Planorbulina Wüllerstorfi (Schwager) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 89, pl. xv. fig. 777.

Fossil. The specimens are small, compared with recent types, and particularly so when compared with those obtained by R. Lechmere Guppy from the Miocene clays of Trinidad, in which deep-water deposits the species occurs of a size such as we have not seen elsewhere.

180. *Truncatulina haidingerii* d'Orbigny sp.

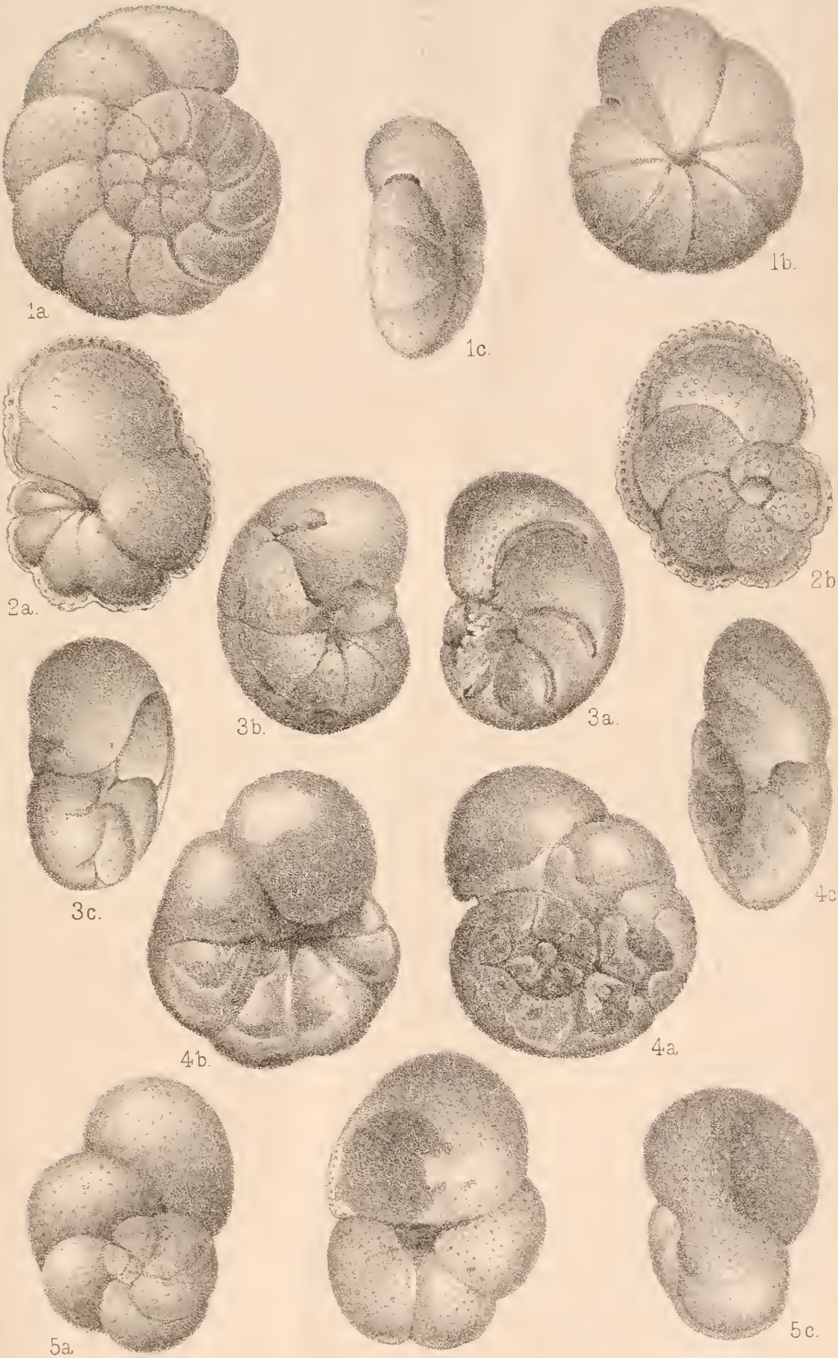
Rotalina haidingerii d'Orbigny, 1846, Foram. Foss. Vienne, p. 154, pl. vii. figs. 7–9.

Planorbulina haidingerii (d'Orbigny) Brady, 1864, Trans. Linn. Soc. Lond. vol. xxiv. p. 469, pl. xlviii. fig. 11.

EXPLANATION OF PLATE XX.

Fig. 1 (*a*).—*Truncatulina ungeriana* d'Orbigny. Superior surface.
,, (*b*).—Ditto. Inferior surface.
,, (*c*).—Ditto. Side view.
,, 2 (*a*).—*Truncatulina tenuimargo* Brady. Inferior surface.
,, (*b*).—Ditto. Superior surface.
,, 3 (*a*).—*Pulvinulina semi-marginata* d'Orbigny. Superior surface.
,, (*b*).—Ditto. Inferior surface.
,, (*c*).—Ditto. Side view.
,, 4 (*a*).—*Pulvinulina concentrica* Parker and Jones. Superior surface.
,, (*b*).—Ditto. Inferior surface.
,, 5 (*a*).—*Pulvinulina hauerii* d'Orbigny. Superior surface.
,, (*b*).—Ditto. Inferior surface.
,, (*c*).—Ditto. Side view.

Figs. 3 *a*, *b*, *c* × 200 diam.; the others × 100 diam.



West, Newman lith.

Planorbulina farcta var. *haidingerii* Parker and Jones, 1865, Phil. Trans., vol. clv. p. 382, pl. xvi. fig. 22, *a*, *b*.
Rotalina haidingerii (d'Orbigny) Terquem, 1882, Mém. Soc. géol. France, sér. iii. vol. ii. Mém. III. p. 80, pl. viii. fig. 4, *a*, *b*. *c*.
Truncatulina haidingerii (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 663, pl. xcv. figs. 7, *a*, *b*, *c*.

Fossil; pyritised.

181. *Truncatulina akneriana* d'Orbigny sp.

Rotalina akneriana d'Orbigny, 1846, Foram. Foss. Vienne, p. 156, pl. viii. figs. 13-15.
Truncatulina akneriana (d'Orbigny) Reuss, 1866, Denkschr. k. Akad. Wiss. Wien, vol. xxv. p. 160, No. 6.
Truncatulina akneriana (d'Orbigny) Brady, Foram. 'Challenger,' p. 663, pl. xciv. fig. 8, *a*, *b*, *c*.
Planorbulina akneriana (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 89, pl. xv. fig. 778, 779.

Fossil and typical; pyritised, probably from a clay.

182. *Truncatulina ungeriana* d'Orbigny sp.

(Plate XX. fig. 1, *a*, *b*, *c*.)

Rotalina ungeriana d'Orbigny, 1846, Foram. Foss. Vienne, p. 157, pl. viii. figs. 16–18.
Planorbulina ungeriana (d'Orbigny) Brady, 1864, Trans. Linn. Soc. Lond., vol. xxiv. p. 469, xlviii. fig. 12.
Planorbulina farcta var. *ungeriana*, Parker and Jones, 1865, Phil. Trans., vol. clv. p. 382, pl. xvi. figs. 23–5.
Truncatulina ungeriana (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 664, pl. xciv. fig. 9 *a*, *b*, *c*.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 226.

Frequent and typical. The majority of the specimens are pyritised fossils, but there are a few which may be of recent origin. The species occurs in Earland's list of Bognor Foraminifera, and is recorded as rare. The specimens were small, typical, and recent at this locality.

183. *Truncatulina robertsoniana* Brady.

Truncatulina robertsoniana Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 65.
Ditto. Brady, 1884, Foram 'Challenger,' p. 664, pl. xcv. fig. 4 *a*, *b*, *c*.

Several small specimens of this pretty form, which have every appearance of being recent. Brady's records are from moderately deep water, ranging from 390 to 1785 fathoms. It does not appear to have been recorded as a fossil.

184. *Truncatulina culter* Parker and Jones sp.

Planorbulina culter Parker and Jones, 1865, Phil. Trans., vol. clv. p. 421, pl. xix. fig. 1 *a*, *b*.
Anomalina bengalensis Schwager, 1866, Novara. Exped. geol. Theil, vol. ii. p. 259, pl. vii. fig. 111.
Truncatulina culter (Parker and Jones) Brady, 1884, Foram. 'Challenger,' p. 668, pl. xcvi. fig. 3 *a*, *b*, *c*.

All fossils, and apparently from a clay. The specimens are small compared with recent types. This species has been recorded principally from depths of 1000 to 2000 fathoms, but, according to Brady, Schwager states that his specimens of *Anomalina bengalensis* were from the shores of the Nicobar Islands, which would point to the fact of their living in comparatively shallow water.

Anomalina d'Orbigny.

185. *Anomalina ammonoides* Reuss sp.

Rosalina ammonoides Reuss, 1845, Verstein. Böhm. Kreid., pt. i. p. 36, pl. xiii. fig. 66, pl. viii. fig. 53.
Ditto. Id., 1850, Haidinger's Naturw. Abhandl., vol. iv. p. 36, pl. iv. fig. 2.
Planorbulina ammonoides (Reuss) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 379.
Anomalina ammonoides (Reuss) Brady, 1884, Foram. 'Challenger,' p. 672, pl. xciv. figs. 2, 3.

Very fine specimens, which have been derived from several distinct sources, including probably Cretaceous beds and Eocene sands and clays.

186. *Anomalina coronata* Parker and Jones.

Anomalina coronata Parker and Jones, 1857, Ann. and Mag. Nat. Hist., ser. 2, vol. xix. p. 294, pl. x. figs. 15, 16.
Ditto. (Parker and Jones) Brady, 1864, Trans. Linn. Soc. Lond., vol. xxiv. p. 469, pl. xlviii. fig. 13 *a*, *b*.
Ditto. (Parker and Jones) Brady, 1884, Foram. 'Challenger,' p. 675, pl. xcvii. figs. 1, 2
Planorbulina coronata (Parker and Jones) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 90, pl. xv. figs. 781–3.

A single small, and imperfect example. The shell is in good preservation, and looks like a recent specimen. This is a very common species in some parts of the North Sea and in the Faröe Channel, but it rarely occurs under the 100 fathom line, and we know no previous record of its occurrence in a shore-sand, if our specimen is to be accepted as recent. The species has been recorded from several Tertiary formations in various parts of the world.

187. *Anomalina grosserugosa* Gümbel sp.

Truncatulina grosserugosa Gümbel, 1868, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. x. p. 660, pl. ii. fig. 104 *a, b*.
Ditto. (Gümbel) Hanthen, 1875, Mittheil. Jahrb. k. ung. geol. Anstalt, vol. iv. p. 74, pl. ix. fig. 6 *a, b*.
Ditto. (Gümbel) Brady, 1884, Foram. 'Challenger,' p. 673, pl. xciv. figs. 4, 5.
Ditto. (Gümbel) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 226.

Several excellent specimens. Fossil, with perhaps one or two exceptions. Earland's record from Bognor (*suprà*) was the first from Britain, but it noted that the specimens were very poor. Its occurrence as a recent British species must therefore still be considered uncertain. Its normal habitat lies between the 500 and 2000 fathom line in both Atlantic and Pacific.

Pulvinulina Parker and Jones.

188. *Pulvinulina punctulata* d'Orbigny sp.

Rotalia punctulata d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 273, No. 25; Modèle No. 12.
Pulvinulina repanda var. *punctulata* (d'Orbigny) Parker and Jones, 1865, Phil. Trans., vol. clv. p 394, pl. xiv. figs. 12, 13
Pulvinulina punctulata (d'Orbigny) Parker, Jones, and Brady, 1865, Ann. and Mag. Nat. Hist., ser. 3, vol. xvi. p. 20, pl. iii. fig. 82.
Pulvinulina repanda (Fichtel and Moll) Jones, Parker, and Brady, 1866, Monograph Foram. Crag, pl. ii. figs. 22–4.
Pulvinulina punctulata (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 685, pl. civ. fig. 17.
Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 96, pl. xvi. figs. 797–800.

One specimen only, but typical. A fossil, probably from a shell-sand. Brady (*suprà*) states that it occurs in the Crag, and our specimen is probably derived from a deposit of this age.

189. *Pulvinulina concentrica* Parker and Jones.

(Plate XX. fig. 4 *a, b, c*.)

Pulvinulina concentrica (Parker and Jones M.S.) Brady, 1864, Trans. Linn. Soc. Lond., vol. xxiv. p. 470, pl. xlviii. fig. 14.
Ditto. Parker and Jones, 1865, Phil. Trans., vol. clv. p. 393.
Ditto. (Parker and Jones) Brady, 1884, Foram. 'Challenger,' p. 686, pl. cv. fig. 1 *a, b, c*.
Ditto. (Parker and Jones) Brady, 1887, Synopsis of British Recent Foraminifera.
Ditto. (Parker and Jones) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 226.

Typical fossil specimens, but no recent ones. The species has been recorded by Earland (*suprà*) in the Bognor specimens, but the specimens were very rare and weak. It is not uncommon in the North Sea at moderate depths. Brady's record was from Shetland, 75 to 90 fathoms.

190. *Pulvinulina vermiculata* d'Orbigny sp.

Planorbulina vermiculata d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 280, No. 3.
Rotalia vermiculata (d'Orbigny) Jones and Parker, 1860, Quart. Journ. Geol. Soc., vol. xvi. p. 305, No. 116.
Pulvinulina vermiculata (d'Orbigny) Carpenter, 1862, Introd. Foram., p. 211, pl. xiii. figs. 4–6.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 687, pl. cxv., fig. 2.
Ditto. (d'Orbigny) Sidebottom, 1909, Mem. Manchester Lit. and Phil. Soc., vol. liii. No. 21, p. 8, pl. iv. fig. 1.

One small but fairly typical specimen of this abnormal species. The reason for its inclusion in the genus *Pulvinulina* is, we must confess, far from obvious. d'Orbigny, who founded the species, referred it to the genus *Planorbulina*, and its affinities certainly seem to lie in this direction. Brady, however, considered that its relationship to *Pulvinulina* could be established by "intermediate gradational forms." Although the species occurs with some frequency in Mediterranean gatherings, we have not ourselves seen sufficient evidence of these intermediate forms to establish its position with any certainty.

191. *Pulvinulina oblonga* Williamson sp.

Nautilus auricula var β, Fichtel and Moll, 1803, Test. Micr., p. 108, pl. xx. figs. *d, e, f*.
Rotalina oblonga Williamson, 1858, Recent Foram. Gt. Britain, p. 51, pl. iv. figs. 98–100.
Pulvinulina repanda var. *auricula* (Fichtel and Moll) Parker and Jones, 1862, Introd. Foram. Appendix, p. 311.
Pulvinulina auricula (Fichtel and Moll sp.) Brady, 1884, Foram. 'Challenger,' p 688, pl. cvi figs. 4, 5.
Pulvinulina oblonga Williamson sp. Ibid.
Pulvinulina auricula (Fichtel and Moll sp.) Brady, 1887, Synopsis British Recent Foraminifera.

Fossil, pyritised. According to Brady, the range of this species does not extend beyond the Tertiary period. The specimens are all referable to Fitchel and Moll's var. β, which differs from var. a, or true *auricula*, in the sharp peripheral edge and limbate sutures. The two forms, however, run together to such an extent that they are hardly worth separation.

192. *Pulvinulina hauerii* d'Orbigny.

(Plate XX. fig. 5 *a, b, c*.)

Rotalina hauerii d'Orbigny, 1846, Foram. Foss. Vienne, p. 151, pl. vii. figs. 22–4.
Pulvinulina hauerii (d'Orbigny) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 393.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 690, pl. cvi. figs. 6, 7.
Ditto. (d'Orbigny) Earland, 1905, Journ. Quekett Micr. Soc., ser. 2, vol. ix. No. 57, p. 227.

Frequent. The specimens are all fossil, and obviously derived from a number of different sources. A few are clearly Cretaceous, whilst others are filled with pyrites, and are probably derived from the Eocene clays. Some of the largest specimens are presumably of later date, and may be from Pliocene sands. Earland's record (*suprà*) from Bognor shore-sand, is the first recent British one.

193. *Pulvinulina menardii* d'Orbigny sp.

Rotalia menardii d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 273, No. 26; Modèle No. 10.
Pulvinulina menardii (d'Orbigny) Brady, 1863, Report British Assoc. Newcastle-on-Tyne Meeting, Trans, p. 101.
Pulvinulina repanda var. *menardii* (d'Orbigny) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 394, pl. xvi. figs. 35–7.
Pulvinulina menardii (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 690, pl. ciii. figs. 1, 2.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 227.

Several good and typical specimens have been found, the largest of which is almost equal in size to the specimens occurring in recent tropical oozes. They are all apparently derived from clays, and to some extent are pyritised. Earland (*suprà*) records small recent specimens from the adjacent Bognor shore-sands, "very rare."

194. *Pulvinulina truncatulinoides* d'Orbigny sp.

Rotalinia truncatulinoides d'Orbigny, 1839, Foram. Canaries, p. 132, pl. ii. figs. 25–7.
Rotalina micheliniana d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 31, pl. iii. figs. 1–3.
Pulvinulina micheliniana (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 694, pl. civ. figs. 1, 2.
Ditto. (d'Orbigny) Wright, 1886, Proc. R. Irish Acad., ser. 2, vol. iv. (Science) p. 614.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

Frequent. The specimens are probably without exception fossils. The best are unquestionably Cretaceous, but there are many others of somewhat more depressed form, which are usually pyritised and are probably derived from Tertiary clays. This species, which is of world-wide distribution, and has a history extending back at least to the Cretaceous period, is singularly unfortunate in its nomenclature. d'Orbigny described it under two different specific names in successive years (*suprà*), and the later name has been almost universally employed by subsequent writers. Following the usual practice, however, the name *truncatulinoides* is entitled to precedence, although its use must lead to confusion. It appears to be a case in which, if ever, the usual practice might be abandoned, especially as Brady (*suprà*) quotes an extract from d'Orbigny which seems to show that the two papers were published almost simultaneously.

195. *Pulvinulina exigua* Brady.

Pulvinulina exigua Brady, 1884, Foram. 'Challenger,' p. 696, pl. ciii. figs. 13, 14.

Several specimens. Fossil, probably derived from a clay. The species has not apparently been recorded in the fossil state previously, but, except for its characteristically minute size, the species is with difficulty separable from *P. elegans*.

196. *Pulvinulina schreibersii* d'Orbigny sp.

Rotalina schreibersii d'Orbigny, 1846, Foram. Foss. Vienne, p. 154, pl. viii. figs. 4–6.
Pulvinulina schreibersii (d'Orbigny) Parker and Jones, 1865, Phil. Trans. vol. clv. p. 393.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 697, pl. cxv. fig. 1.
Ditto. (d'Orbigny) Goës, 1894, Artic and Scandinavian Foraminifera, p. 98.

Fossil. Rare, but typical, and in excellent preservation. The records of this form extended back to the Miocene. It is abundant in the Miocene clays of Gozo (Malta).

197. *Pulvinulina karsteni* Reuss sp.

Rotalia karsteni Reuss, 1855, Zeitschr. deutsch. geol. Gesellsch., vol. vii. p. 273, pl. ix. fig. 6.
Pulvinulina karsteni (Reuss) Brady, 1864, Trans. Linn. Soc. Lond., vol. xxiv. p. 470, pl. xlviii. fig. 15.
Ditto. (Reuss) Brady, 1884, Foram. 'Challenger,' p. 698, pl. cv. figs. 8, 9.
Ditto. (Reuss) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Reuss) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 227.

Rare; fossil. This species in the recent state is best known as a cold-water form, although it has been dredged at one or two localities round the British coasts, and has been recorded by Earland (*suprà*) from the Bognor shore-sands, "very rare, very small." The Selsey specimens are probably derived from post-Glacial deposits.

198. *Pulvinulina elegans* d'Orbigny sp.

Rotalia (*Turbinulina*) *elegans* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 276, No. 54.
Rotalina partschiana d'Orbigny, 1846, For. Foss. Vienne, p. 153, pl. vii. figs. 28–30, pl. viii. figs. 1–3.

Pulvinulina repanda var. *elegans* (d'Orbigny) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 397, pl. xvi. figs. 44–6.
Pulvinulina elegans (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 699, pl. cv. figs. 3–6.
Pulvinulina partschiana (d'Orbigny). Ibid.
Pulvinulina elegans (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 97, pl. xvi. fig. 808.

Fossil specimens, fairly well developed and typical, probably from a clay. The species and its ally *P. partschiana* have been recorded from various deposits ranging back as far as the Upper Trias.

199. *Pulvinulina semimarginata* d'Orbigny sp.

Plate XX. fig. 3 *a, b, c.*

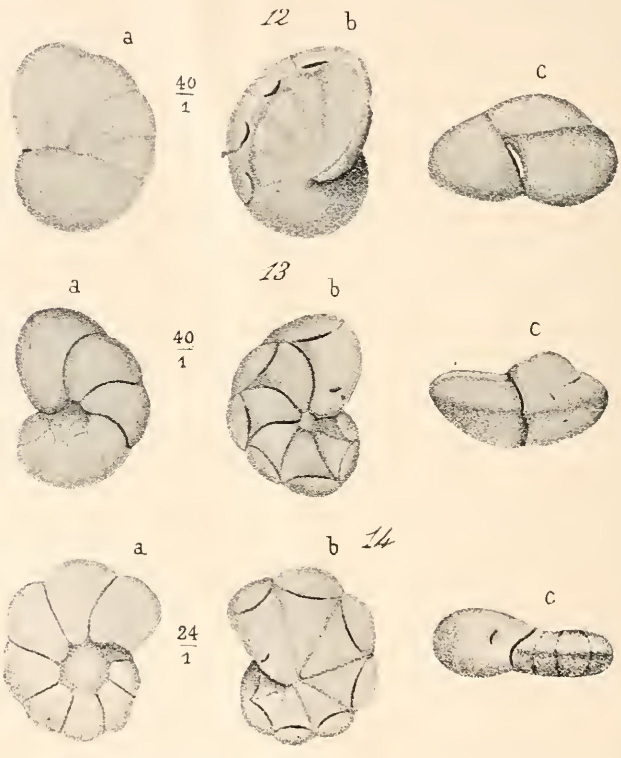
Turbinulina semimarginata d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 276, No. 53. "Planches inédites," pl. ix. fig. 53.
Rosalina semimarginata (d'Orbigny) 1850, Prodrome de Palæontologie, p. 407.
Rotalina semimarginata (d'Orbigny) Terquem, 1882, Mém. Soc. Géol. France, sér. 3, vol. ii. No. 3, p. 56, pl. iii. figs. 12–14.

One fossil specimen, in excellent preservation. There can be no doubt as to the identity of the specimen which we figure with the form described and figured by Terquem as above, but as to the identity of Terquem's specimens with d'Orbigny's species we can say nothing, as this was one of the forms of which d'Orbigny published no figure, and his description ("espèce rugeuse, ovale, bordée interieurement") is too vague to have any value. Terquem, however, appears to have had access to d'Orbigny's figure in the "Planches inédites," and gives a complete series of drawings of his own specimens, which were from the Eocene of Vaudancourt and Septeuil, near Paris. Terquem's figures must therefore be accepted as the foundation of our knowledge of this species. There are nine in all, representing different views of three individuals, which differ to some extent in size, thickness, and markings, but which may probably be regarded as mere variations within the species. Terquem gives a separate description of each of these specimens, and as his paper is not readily accessible, we deem it advisable to give here reproductions of his figures, and a précis of his descriptions.

Fig. 12 *a, b, c.*—Shell oval, compressed, smooth, of rounded circumference, sub-convex above, compressed below, the two surfaces formed of a spiral whorl, the earlier chambers indistinct, the four later ones slightly prominent, encroaching on the inferior surface, and bounded by a furrow not in conformity with the chambers of this surface. The edge of the terminal chamber is prominent, the aperture a slit, close against the spiral. (Vaudancourt.)

Fig. 13 *a, b, c.*—Shell oval, sub-convex above, depressed below, the upper surface formed of early chambers indistinctly indicated, the three later chambers being prominent. On the inferior surface all the chambers are prominent, the three latest being swollen. A secondary aperture on the anterior surface of the terminal chamber. (Septeuil.)

Fig. 14 *a, b, c.*—Shell circular, compressed on both sides, rounded circumference, with a nucleus. The superior surface formed of



strongly marked chambers with deep sutural lines. On the inferior surface the outer chambers prominent, the inner triangular and well marked. Secondary aperture, a slit on the anterior surface of the last chamber. (Septeuil.)

Terquem adds that the species is formed of two series of chambers in juxtaposition. The upper series, which encroaches upon the lower, frequently has a specialised aperture situated in the middle of the terminal chamber. The lower, which exceeds the upper in development, shows five chambers, whilst the upper has but four, occupying the same area.

Judging from our own specimen, we do not think that Terquem is correct in stating that the shell is built up of two sets of chambers. If his statement were correct, the specimens could not be referred to the genus in which he places them, but would be more correctly assigned to *Bulimina*—indeed, his drawings, especially figs. 13 and 14, are not unlike *Bulimina convoluta* Williamson; but it appears to us that the constrictions and incisions (slits) to which he refers in his description are not lines of demarcation between two separate series of chambers, but merely subsidiary marginal apertures, such as are found in certain species of *Pulvinulina* (cf. *P. elegans* d'Orbigny), and for which Terquem himself proposed the sub-genus *Epistomina*. Our specimen, as will be seen from the drawing, approaches and is almost identical with Terquem's fig. 12, and there is very little doubt that it has been derived from a similar Eocene formation. The shell presents a somewhat worn and whitish appearance, such as is characteristic of the Paris Eocene beds.

Rotalia Lamarck.

200. *Rotalia beccarii* Linné sp.

Nautilus beccarii Linné, 1767, Syst. Nat., 12th ed. p. 1162; 1788, ibid. 13th (Gmélin's) ed., p. 3370, No. 4.
Rotalia (*Turbinularia*) *beccarii* (Linné) d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p 275, No. 42; Modèle No. 74.
Rotalina beccarii (Linné) Williamson, 1858, Recent Foram. Gt. Britain, p. 48, pl. iv. figs. 90–2.
Rotalia beccarii (Linné) Brady, 1884, Foram. 'Challenger,' p. 704, pl. cvii. figs. 2, 3.
Ditto. (Linné) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Linné) Earland, 1905, Journ. Quekett. Micr. Club, ser. 2, vol. ix. No. 57, p 228.
Ditto. (Linné) Sidebottom, 1909, Mem. Manchester Lit. and Phil. Soc., vol. liii. No. 21, p. 10, pl. iv. fig. 6.

Very common, both recent and fossil; the latter derived from many sources, ranging from the Bracklesham clays to recent. Among the recent specimens, besides the typical *R. beccarii*, the smooth thin-shelled variety recorded by Earland (*suprà*) from Bognor, also occurs. Among the fossils are one or two of the tuberculate variety figured by Sidebottom (*suprà*), which, it appears from his paper, has also been found by Millett in the Pliocene beds of St. Erth. Such specimens are abundant in some of the Italian Tertiaries.

201. *Rotalia* (*Gyroidina*) *orbicularis* d'Orbigny.

Rotalia (*Gyroidina*) *orbicularis* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 278, No. 1; Modèle No. 13.
Rotalia orbicularis (d'Orbigny) Brady, 1864, Trans. Linn. Soc. Lond., vol. xxiv. p. 470, pl. xlviii. fig. 16.

Rotalia orbicularis (d'Orbigny) Terquem, 1882, Mém. Soc. géol. France, ser. 3, vol. ii. No. 3, p. 60, pl. iv. figs. 1–3.
Ditto. (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 706, pl. cvii. fig. 5; pl. cxv. fig. 6.
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.

A few fossil specimens, rather worn, which are, however, clearly referable to this species. It has been recorded from the London Clay, and many later formations. Our specimens are probably derived from the Tertiary shell sands of the Bognor rocks.

202. *Rotalia soldanii* d'Orbigny.

Rotalia (*Gyroidina*) *soldanii* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 278, No. 5; Modèle No. 36.
Rotalia beccarii var. *soldanii* (d'Orbigny) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 389, pl. xvi., figs. 31–3.
Rotalia soldanii (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 706, pl. cvii. figs. 6, 7.
Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p 99, pl. xvi. fig. 812.

Frequent; fossil, and probably derived from Cretaceous and perhaps from other and later deposits.

203. *Rotalia exsculpta* Reuss.

Rotalia exsculpta Reuss, 1860, Sitz. k. Akad. Wiss. Wien, vol. xl. p. 222, pl. xi. fig. 4.

Frequent, and typical specimens of this Cretaceous fossil. Owing to its minute size and the fact that the typical markings are frequently so clogged with chalk as to be indistinguishable, this pretty little form is probably often overlooked. At any rate, there appear to be very few records of its occurrence since Reuss first described it from the Westphalian chalk. It seems to be pretty generally distributed throughout the chalk, but is apparently confined to that formation. Jones and Parker* consider it closely allied to the *Rosalina ornata* of d'Orbigny.†

204. *Rotalia suessonensis* d'Orbigny.

Rotalia suessonensis d'Orbigny, 1826, Ann Sci. Nat., vol. vii. p. 273, No. 23.
Ditto. d'Orbigny, "Planches inédites," pl. viii fig 23.
Ditto. d'Orbigny, 1850, Prodrome de Palæontologie, vol. ii. p. 336.
Ditto. (d'Orbigny) Terquem, 1882, Mém. Soc. géol. France, ser. 3, vol. ii. No. 3, p. 65, pl. v. figs. 3, 4.

One fossil specimen, somewhat worn, but identifiable with Terquem's fig. 3. Fig. 4 is somewhat different, and probably re-

* T. Rupert Jones and W. K. Parker in Quart. Journ. Geol. Soc. May 1872, p. 108. "On the Foraminifera of the family Rotalinae found in the Cretaceous Formations, etc."

† Voyage Amér. Mérid. 1839, vol. v. pt. 5, p. 42, pl. i. fig. 18–20.

presents a distinct type. d'Orbigny published no figure of this species, and his description ("espèce plus convex en dessus qu'en dessous") would not go far towards identification. Terquem, however, appears to have had access to d'Orbigny's figure in the "Planches inédites." The shell is smooth and almost hemispherical on the superior face. The inferior or oral face is less convex, but the central portion rises in a pronounced umbo or boss. The sutures between the chambers are marked by deep clefts, which, however, do not extend either to the umbo or the periphery. Terquem's specimens were from the Eocene of Paris.

205. *Rotalia calcar* d'Orbigny sp.

Plate XXI., fig. 1, *a*, *b*, *c*.

Calcarina calcar d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 276, No. 1; Modèle No. 34.
Rotalia armata d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 273, No. 22; Modèle No. 70.
Ditto. (d'Orbigny) Terquem, 1882, Mem. Soc. geol. France, ser. 3, vol. ii. No. 3, p. 67, pl. v. figs. 14, 15.
Rotalia calcar (d'Orbigny) Earland, 1905, Journ. Quekett Micr. Club, ser. ii. vol. ix. No. 57, p. 228.

Abundant, in every stage of development, and from several distinct strata. All the specimens are unquestionably fossil, and doubtless Earland's record from the Bognor shore-sands (*suprà*) must now be removed from the list of recent British forms, as his specimens, which were small and rare, have probably been derived from the same strata as some of the smaller Selsey specimens, to which they bear great resemblance.

Sub-Family 3. **Tinoporinae.**

Gypsina Carter.

206. *Gypsina inhærens* Schultze sp.

Acervulina inhærens Schultze, 1854, Organ. der Polythal., p. 68, pl. vi. fig. 12.
Tinoporus lucidus Brady, 1870, Edinburgh Catalogue of British Foram., p. 8.
Ditto. (Brady) Wright, 1877, Proc. Belfast Nat. Field Club, 1876–7, App. p. 105, pl. iv. figs. 4, 5.
Gypsina inhærens (Schultze) Brady, 1884, Foram. 'Challenger,' p. 718, pl. cii. figs. 1–6.
Ditto. (Schultze) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Schultze) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 91, pl. xv. fig. 787.

Abundant; recent and fossil. The latter are evidently derived from several distinct sources. Brady states that there is no record of its occurrence as a fossil, but it seems unlikely that such a simple type should not have a considerable geological range.

Polytrema Risso.

207. *Polytrema miniaceum* Linné sp.

Millepora miniacea Linné, 1788, Syst. Nat., 13th (Gmelin's) ed., vol. i. pt. 6, p. 3784, No. 6.
Polytrema miniacea (Linné) Carpenter, 1862, Introd. Foram., p. 235, pl. xiii. figs. 18–20.
Polytrema miniaceum (Linné) Moebius, 1880, Foram. von Mauritius, p. 85, pl. vii.
Ditto. (Linné) Brady, 1884, Foram. 'Challenger,' p. 721, pl. c. figs. 5–9; pl. ci. fig. 1.

We have a few fragments which can hardly be ascribed to any organism other than *Polytrema*, especially as they preserve both the colour and the typical perforate exterior rugosity of the test, but in the absence of more perfect specimens, the species is recorded with some reservation. The fossil records of *Polytrema* are very confusing, owing to the superficial resemblance to a zoophyte, and Brady states that little can be said with certainty as to its occurrence as a fossil. Without a re-examination of the specimens, it is impossible to say how many of the fossil records belong to the genus as at present constituted.

Family X. NUMMULINIDÆ.

Sub-family 2. **Polystomellinæ.**

Nonionina d'Orbigny.

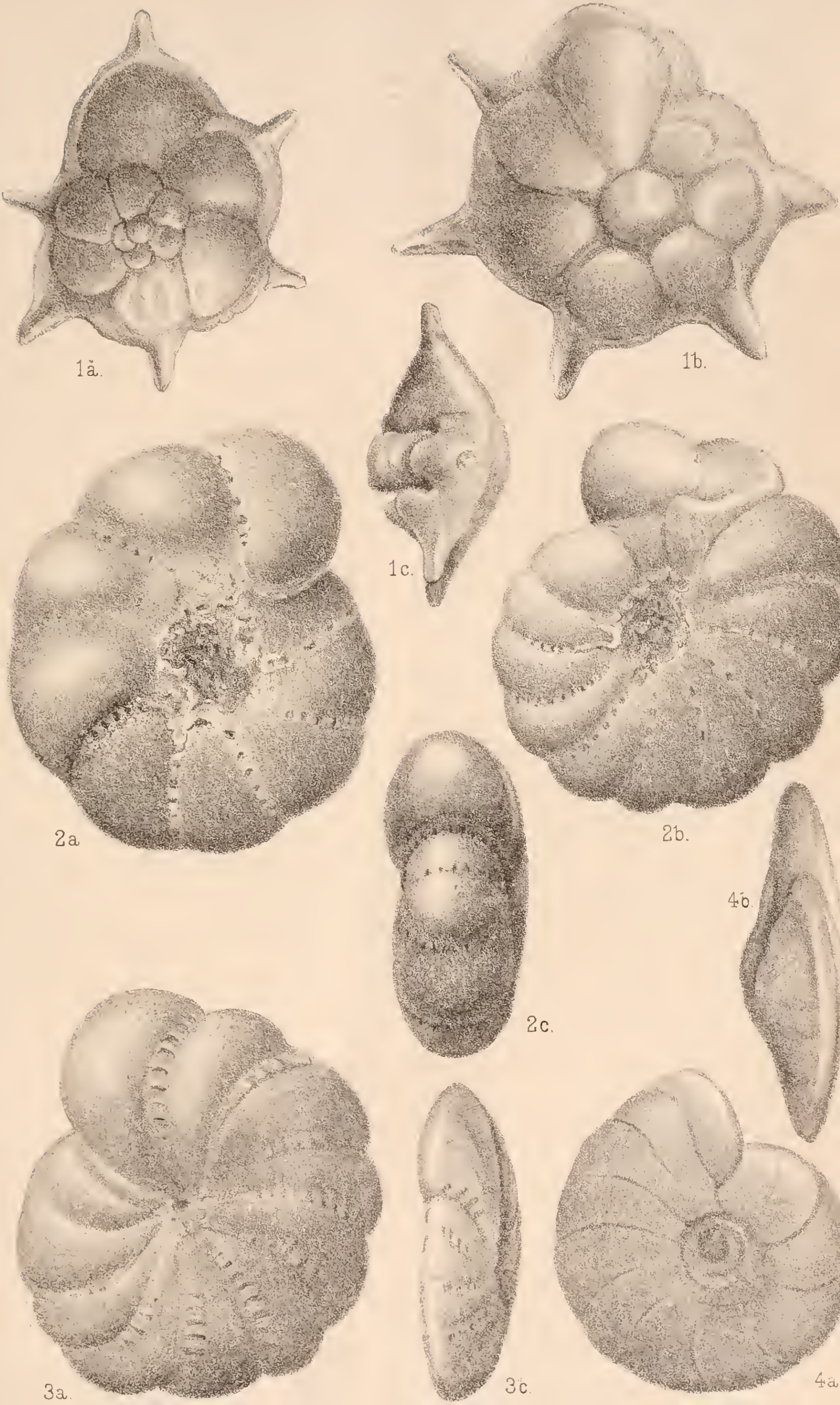
208. *Nonionina depressula* Walker and Jacob sp.

Nautilus depressulus Walker and Jacob, 1798, Adam's Essays, Kanmacher's Edition, p. 641, pl. xiv. fig. 33.
Nonionina umbilicatula Williamson, 1858, Recent Foram. Gt. Britain, p. 97, pl. iv. figs. 70, 71.
Nonionina crassula Williamson, ibid, p. 33.
Nonionina depressula (Walker and Jacob) Brady, 1884, Foram. 'Challenger,' p. 725, pl. cix. figs. 6, 7.

EXPLANATION OF PLATE XXI.

Fig. 1 (*a*).—*Rotalia calcar* d'Orbigny. Superior surface.
,, (*b*).—Ditto. Inferior surface.
,, (*c*).—Ditto. Side view.
,, 2 (*a*).—*Polystomella striato-punctata* Fichtel and Moll. Selsey and Bognor variety, with central (umbilical) deposit. Superior surface.
,, (*b*).—Ditto. Inferior surface.
,, (*c*).—Ditto. Side view.
,, 3 (*a*).—*Polystomella macella* Fichtel and Moll. Superior surface.
,, (*b*).—Ditto. Side view.
,, 4 (*a*).—*Operculina complanata* Defrance. Superior surface.
,, (*b*).—Ditto. Side view.

All figures × 100 diam.


1a.
1b.
1c.
2a
2b.
2c.
4b.
3a.
3c.
4a

Nonionina depressula (Walker and Jacob) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Walker and Jacob) Goës, 1894, Arctic and Scandinavian Foraminifera, p 103, pl. xvii. figs. 825-6.

Abundant, both recent and fossil. Many of the finest specimens are highly pyritised, and probably derived from the post-Glacial deposits of the peninsula. The finest of our specimens come from the extreme limit of our gathering at West Wittering. The specimens exhibit an unusual range in thickness, some of them approaching very closely to *N. orbicularis.*

209. *Nonionina umbilicatula* Montagu sp.

Nautilus umbilicatus Montagu, 1803, Test. Brit., p. 191; Suppl. p. 78, pl. xviii. fig. 1.
Nonionina soldanii d'Orbigny, 1846, For. Foss. Vienne, p. 109, pl. v. figs. 15, 16.
Nonionina barleeana Williamson, 1858, Recent Foram. Gt. Britain, p. 32, pl. iv. figs. 68, 69.
Nonionina umbilicata Terquem, 1882, Mém. Soc. géol. France, sér. 3, vol. ii. No. 3, p. 42, pl. ii. fig. 7.
Nonionina umbilicatula (Montagu) Brady, 1884, Foram. 'Challenger,' p. 726, pl. cix. figs. 8, 9.
Ditto. (Montagu) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Montagu) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 103, pl. xvii. figs. 823-4.

Frequent. Fossil, and perhaps recent, the latter doubtful.

210. *Nonionina pompilioides* Fichtel and Moll sp.

Nautilus pompilioides Fichtel and Moll, 1803, Test. Micr., p 31, pl. ii. figs. *a–e*.
Nonionina pompilioides (Fichtel and Moll) Parker, Jones, and Brady, 1865, Ann. and Mag. Nat. Hist., ser 3. vol. xvi p. 18, pl. iii. fig. 98.
Ditto. (Fichtel and Moll) Brady, 1884, Foram. 'Challenger,' p. 727, pl. cix. figs. 10, 11.

Frequent. Fossil. The specimens are for the most part rather starved, and are probably derived from several distinct sources. A few of them are pyritised.

211. *Nonionina orbicularis* Brady.

Nonionina orbicularis Brady, 1881, Denkschr. k. Akad. Wiss. Wien, vol. xlii. p. 105, pl. ii. fig. 5.
Ditto. Brady, 1881, Ann. and Mag. Nat. Hist, ser. v. vol. viii. p. 415, pl. xxi. figs. 5 *a*, *b*.
Ditto. Robertson 1882, Proc. Nat. Hist. Soc. Glasgow, vol. v. p. 274.
Ditto. (Brady) Brady, 1884, Foram. 'Challenger,' p. 727, pl. cix. figs. 20, 21.
Ditto. (Brady) Brady, 1887, Synopsis British Recent Foraminifera.

Typical specimens are not of very frequent occurrence. Such as we have found are fossils probably from the post-Glacial boulder clay. The records of this species are mostly confined to cold areas. According to Brady, it occurs in the post-Tertiary clays of Fifeshire. We have also fossil specimens from the neighbourhood of Montreal (Canada), stated to be from a post-Glacial clay.

212. *Nonionina asterizans* Fichtel and Moll sp.

Nautilus asterizans Fichtel and Moll., 1803. Test. Micr., p. 37, pl. iii. figs. *e–h*.
Nonionina asterizans (Fichtel and Moll) Parker and Jones, 1860, Ann. and Mag. Nat. Hist., ser. 3, vol. v. p. 101, No. 1.
Polystomella crispa var. (*Nonionina*) *asterizans* (Fichtel and Moll) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 403, pl. xiv. fig. 35; pl. pl. xvii. fig. 54.
Nonionina ast rizans (Fichtel and Moll) Brady, 1884, Foram. 'Challenger,' p. 728, pl. cix. figs. 1, 2.
Ditto. (Fichtel and Moll) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Fichtel and Moll) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 229.

Fossil, and recent, the latter abundant. The recent specimens are of the same weak type as those referred to in Earland's paper (*suprà*).

213. *Nonionina boueana* d'Orbigny.

Nonionina boueana d'Orbigny, 1864, Foram. Foss. Vienne, p. 108, pl. v. figs. 11, 12.
Ditto. (d Orbigny) Brady, 1884, Foram. 'Challenger,' p. 729, pl. cix. figs. 12, 13
Ditto. (d'Orbigny) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (d'Orbigny) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 104, pl. xvii. fig. 829.

Fossil. A few specimens only.

214. *Nonionina scapha* Fichtel and Moll. sp.

Nautilus scapha Fichtel and Moll, 1803, Test. Micr., p. 105, pl. xix. figs. *d, e, f*.
Nonionina scapha (Fichtel and Moll) Parker and Jones, 1860, Ann. and Mag. Nat. Hist., ser 3, vol. v. p. 102, No 4.
Ditto. (Fichtel and Moll) Brady, 1865, Nat. Hist. Trans. Northumberland and Durham, vol. i. p. 106, pl. xii. fig. 10.
Ditto. (Fichtel and Moll) Brady, 1884, Foram. 'Challenger,' p. 730, pl. cix. figs. 14, 15, 16 (?).
Ditto. (Fichtel and Moll) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Fichtel and Moll) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 104, pl. xvii. fig. 830.

Rare. Fossils, derived from various sources, some being pyritised.

Polystomella Lamarck.

215. *Polystomella striatopunctata* Fichtel and Moll sp.

(Plate XXI. fig. 2 *a*, *b*, *c*.)

Nautilus striatopunctatus Fichtel and Moll, 1803, Test. Micr., p. 61, pl. ix. figs. *a*, *b*, *c*.
Polystomella poeyana d'Orbigny, 1839, Foram. Cuba, p. 75, pl. vi. figs. 25, 26.
Polystomella umbilicatula Williamson, 1858, Recent Foram. Gt. Britain, p. 42, pl. iii. figs. 81, 82.
Polystomella umbilicatula var. *incerta* Williamson, ibid., p. 44, pl. iii. fig. 82 *a*.
Polystomella striatopunctata (Fitchel and Moll) Parker and Jones, 1860, Ann. and Mag. Nat. Hist., ser. iii. vol. v. p. 103, No. 6.
Polystomella antonina (d'Orbigny) Terquem, 1882, Mém. Soc. géol. France, ser. 3, vol. ii No. 3, p. 47, pl. ii fig. 25 *a*, *b*.
Polystomella striatopunctata (Fichtel and Moll) Brady, 1884, Foram. 'Challenger,' p. 733, pl. cix. figs. 22, 23.
Ditto. (Fichtel and Moll) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Fichtel and Moll) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 101, pl. xvii. figs. 815, 816.

Very common, both recent and fossil, and presenting practically every modification of this variable type. Among the recent specimens many of the largest present a modification of the usual structure—which we have thought of sufficient interest to figure. The shell is of a complanate and evolute type, and somewhat excavate at the umbilicus, which is more or less filled in with a vesicular extension of the final whorl of chambers, thus presenting as it were a secondary deposit of chamberlets in the middle of the shell. This variety also occurs in some abundance at Bognor.

216. *Polystomella crispa* Linné sp.

Nautilus crispus Linné, 1767, Syst. Nat., 12th ed. p. 1162, 275.
Polystomella crispa (Linné) Lamarck, 1822, Anim. sans Vert., vol. vii. p. 625. No. 1.
Ditto. (Linné) Williamson, 1858, Recent Foram. Gt. Britain, p. 40, pl. iii. figs. 78–80.
Ditto. (Linné) Brady, 1884, Foram. 'Challenger,' p. 736, pl. cx. figs. 6, 7.
Ditto. (Linné) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Linné) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 102, pl. xvii. figs. 820, 821.

Abundant, both recent and fossil, and in all stages of development. The spinous, young specimens are particularly fine.

The range of this handsome species extends back at least as far as Eocene times, and it is of frequent occurrence in most later deposits.

217. *Polystomella macella* Fitchel and Moll sp.

(Plate XXI. fig. 3*a*, *b*.)

Nautilus macellus var. *a*, Fichtel and Moll, 1803, Test. Micr., p. 66, pl. x. figs. *e*, *f*, *g*.
Polystomella planulata Lamarck, 1822, Anim. sans Vert., vol. vii. p. 625, No. 3.
Polystomella macella (Fichtel and Moll) Parker and Jones, 1860, Ann. and Mag. Nat. Hist., ser. 3, vol. v. p. 104, No. 8
Ditto. (Fitchel and Moll) Brady, 1884, Foram. 'Challenger,' p. 737, pl. cx. figs. 8, 9, 11, and 10 (?).
Ditto. (Fichtel and Moll) Earland, 1905, Journ. Quekett Micr. Club, ser. 2, vol. ix. No. 57, p. 230.

Common, both recent and fossil. The species is commonly distributed all round our coast, and extends at least as far north as Shetland, but it was not recorded as a British form until 1900, when J. Wright published his list of Foraminifera from Dog's Bay, Connemara.*

Sub-family 3. **Nummulitinae.**

Amphistegina d'Orbigny.

218. *Amphistegina lessonii* d'Orbigny.

Amphistegina lessonii d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 304, No. 3, pl. xvii. figs. 1–4.
Amphistegina nucleata Terquem, 1882, Mém. Soc. géol. France, sér. 3, vol. ii. No. 3, p 123, pl. xiii. fig 1.
Amphistegina lessonii (d'Orbigny) Brady, 1884, Foram. 'Challenger,' p. 739, pl. cxi. figs. 1–7.

A number of small and somewhat worn specimens are probably referable to this species, and are derived from the *Alveolina* limestone of the Mixon Rocks, having in many cases portions of the silicious matrix attached. The species has been recorded as far back as the Eocene of the Paris basin, and is abundant in many Miocene deposits.

Operculina d'Orbigny.

219. *Operculina complanata* Defrance sp.

(Plate XXI., fig. 4*a*, *b*.)

Lenticulites complanata Defrance, 1822, Dict. Sci. Nat., vol. xxv. p. 453.
Operculina complanata (Defrance) d'Orbigny, 1 26 Ann. Sci. Nat., vol. vii. p. 281, pl. xiv. figs. 7–10; Modèle No 80.
Ditto. (Defrance) Brady, 1884, Foram. 'Challenger,' p. 743, pl. cxii. figs. 3, 4, 5, 8.

* Irish Naturalist, March 1900.

Small specimens similar to our illustration are of moderately frequent occurrence, and are probably miniature shells of the species to which we have referred them. They are, at any rate, indistinguishable from the minute *Operculinæ,* which may be found in recent tropical gatherings; but we have seen no mature shells, either entire or fragmentary, so the species must be accepted on the evidence of these specimens only.

220. *Operculina ammonoides* Gronovius sp.

Nautilus ammonoides Gronovius, 1781, Zooph. Gron., p. 282, No. 1220, p. v.
Operculina complanata (Defrance) Parker and Jones, 1857, Ann. and Mag. Nat. Hist., ser. 2, vol xix. p. 285, pl. xi. figs. 3, 4.
Nonionina elegans Williamson, 1858, Recent Foram. Gt. Britain, p. 35, pl. iii. figs. 74, 75.
Operculina ammonoides (Gronovius) Parker and Jones, 1862, Introd. Foram. Appendix, p. 810.
Ditto. (Gronovius) Brady, 1884, Foram. 'Challenger,' p. 745, pl. cxii. figs. 1, 2.
Ditto. (Gronovius) Brady, 1887, Synopsis British Recent Foraminifera.
Ditto. (Gronovius) Goës, 1894, Arctic and Scandinavian Foraminifera, p. 105, pl. xvii. fig. 833.

Two specimens, one fossil, the other apparently recent. This species is frequent in the North Sea at moderate depths, and has been recorded from post-Tertiary deposits.

Nummulites Lamarck.

221. *Nummulites planulata* Lamarck.

222. *Nummulites lævigata* Lamarck.

223. *Nummulites variolaria* Sowerby.

224. *Nummulites elegans* Sowerby.

225. *Nummulites Wemmelensis* de la Harpe.

Nummulites lævigata Lamarck, 1801, Syst. Anim. sans Vert., p. 101.
Ditto. (Lamarck) 1804, Ann. Mus., vol. v. p. 241.
Ditto. (Lamarck) 1806, Ann. Mus., vol. viii. No. 1, figs. 10 *a*, *b*, pl. lxii.
Nummulites lævigatus Brug. (*Lamarcki* d'Archiac) Lister, 1905, Proc Roy. Soc., vol. B. lxvi., pp. 298–318, pl. iii.

Specimens of these Nummulites, which are found of every dimension, from the most microscopic forms up to specimens 1·5 cm. in diameter, occur in every gathering we have made along the shores of Selsey Bill, from Pagham Harbour to West Wittering, and they present a complete series of microspheric and megalospheric forms, running from one species into another, from *N. planulata* to *N. Wemmelensis* (or *Prestwichii*), and it would be beyond the scope of the present paper to attempt anything like a complete classification of the series. As far as our researches have taken us, in examining the clays from the artesian well-boring at "Large Acres," Selsey, we have found a mass of shells presenting every feature of the series as classified by Lister, and we must defer a more serious study of the genus to a future date when dealing with this well-boring. Some of the most characteristic and robust forms occur in the interior of the shells of the gigantic *Pholas* which occur in well-defined beds at various points of the coast, as well as among the detrital sand gathered at the base of the Mixon Beacon, whilst the finer and more delicate forms are found among the derived fossils in the shore gatherings in which the species washed from the outlying Eocene mud-banks ("clibs") are most numerous. Mr. J. J. Lister, F.R.S., has been good enough to look over some of our Selsey specimens, and considers the majority to be *N. variolaria* (Sowerby), though many nearly approach his species *N. Wemmelensis* var. *elegans.* The larger specimens are practically without exception *N. lævigata* (Lamarck).

OBITUARY.

Rev. W. H. Dallinger, LL.D. D.Sc. D.C.L. F.R.S. F.L.S. F.Z.S.

President 1884-5-6-7. Secretary 1891-1907.
Vice-President 1908-9.

Plate XXII.

William Henry Dallinger was born at Devonport, on July 5, 1840. Even when young he evinced a liking for natural science, and at one time contemplated entering the medical profession, but his devout spirit and religious temperament predominated, and while still a youth he elected to serve in the Wesleyan ministry. In 1861 he was appointed to his first circuit, that of Faversham, and subsequently travelled those of Cardiff, Bristol and Liverpool. Till 1880 his life was that of the ordinary circuit minister, but his leisure hours were devoted to a study of science, and to acquiring a knowledge of Hebrew, Greek and German.

In 1880 he was appointed Governor and Principal of Wesley College, Sheffield, and after a successful eight years' headship he resigned this post in 1888 in order to become a minister without pastoral charge, so that he might have more leisure to follow his scientific studies and prosecute his researches.

The last 21 years of his life were spent chiefly in scientific pursuits and in giving lectures on microscopical and biological subjects, such as "The Infinitely Little," "An Hour with the Microscope," "Spiders," "The Lowest and Smallest Forms of Animal Life," the last of these being delivered before the British Association at Montreal in 1884.

The researches which made his name famous began about 1870, when in conjunction with J. Drysdale, he published a series of papers on the Life-history of Monads. Many of the experiments and observations bore directly on the question of spontaneous generation, then a subject of burning interest, and the results of their inquiries had a great share in determining the decision, though it must be admitted that the protagonist, Dr. Charlton Bastian, still stands to his guns. Perhaps the most interesting of these researches was that which showed how certain Flagellates, normally living at a temperature of 60° F., could, by a gradual raising of the temperature of the circumambient fluid, be accustomed not only to live but to thrive at 158° F. The only material structural difference detected in these organisms was a marked vacuolation. Though these observations on Monads were practically all Dallinger's scientific work, it was the patient, untiring, continuous method which rendered them truly scientific.

He did not rush into print, and his observations were confirmed over and over again before they were published. How different from much of the trumpery "original research" of the present day!

In 1880 Dallinger was elected to the Fellowship of the Royal Society, and shortly after received an unsolicited grant of £100 to assist him in his researches.

Dr. Dallinger joined the Society in 1871, and was President in 1884-5-6-7, and it was in his Presidential Addresses that he communicated many of the important and interesting results of his observations on minute organisms. But no one can read these addresses without feeling how impressed he was with the "brass and glass" side of the observations.

His interest in the Society was always, even to the end, very great, and he was rarely absent from its meetings until the last few years of his life. In order to attend these meetings he often travelled hundreds of miles. Thus when President he was Principal of Wesley College, and during this period he usually travelled back to Sheffield by the night mail after a meeting, in order to undertake his duties at the College next morning: a convincing example of conscientiousness and devotion to duty.

There will be found very few men who, after holding the supreme office, are willing to accept a subordinate position, as Dallinger did when he allowed himself to be nominated Joint-Secretary of the Society; this condescension was of great service, as his eminent name was in itself a pillar of strength. For some years past his health was very precarious, and his attendance at the Meetings so infrequent, that most of the more recently elected Fellows knew him only by his reputation.

In addition to being elected F.R.S. in 1850, Dr. Dallinger received the following distinctions: LL.D. from Victoria University in 1884, D.Sc. from Dublin in 1892, and D.C.L. from Durham in 1896. In 1890, 1891, 1892 he was president of the Quekett Microscopical Club. In 1896 he published his well-known "Fernley Lecture" on "The Creator, and what we may know about Creation"; also "Life Histories and their Lessons; a Defence of the Uniformity and Stability of Vital Processes as controlled by the Laws of Evolution." He frequently contributed scientific articles to the "Wesleyan Methodist Magazine": but the work by which he is best known to microscopists all over the world is his edition of Carpenter on "The Microscope and its Revelations," published in 1891 and 1901, being the 7th and 8th editions of the original work. In both of these he showed how conversant he was with Brass and Glass and Biological sides of the Microscope.

In conclusion, we would recall the prescient and prophetic words of his address in 1888: *

* See this Journal, 1888, p. 177.

Rev. W. H. Dallinger.

"I think it may be now fairly taken for granted that, as this Society has from the outset promoted and pointed to the higher scientific perfection of the Microscope, so now more than ever it is its special function to place this in the forefront as its *raison d'etre.* The Microscope has been long enough in the hands of amateur and expert alike to establish itself as an instrument having an application to every actual and conceivable department of human research; and whilst in the earlier days of this Society it was possible for a zealous Fellow to have seen, and been more or less familiar with, all the applications to which it had been put, it is different to-day. Specialists with most diverse areas of research are assiduously applying the instrument to their various subjects, and with results that, if we would estimate aright, we must survey with instructed vision the whole ground which advancing science covers.

"From this it is manifest that this Society cannot hope to enfold, or at least to organically bind to itself men whose objects are so diverse.

"But these are all linked by one inseparable bond—it is the Microscope; and whilst amidst the inconceivable diversity of its applications, it remains manifest that this Society has for its primary object the constant progress of the instrument, whether in its mechanical construction or its optical appliances; whether the improvements shall bear upon the use of high powers or low powers; whether it shall be improvement which shall apply to its commercial employment, its easier professional application, or its most exalted scientific use—so long as this shall be the undoubted aim of the Royal Microscopical Society, its existence may well be the pride of Englishmen, and will commend itself more and more to men of all countries.

"This and this only can lift a Society of this sort out of what I believe has ceased to be our danger, that of forgetting that in proportion as the optical principles of the Microscope are understood, and the theory of microscopical vision is made plain, the value of the instrument over every region to which it can be applied, and in all the varied hands that use it, is increased without definable limit."

R. G. H.

Papers read before the Society by Dr. Dallinger, F.R.M.S.

Researches on the Life-history of a Cercomonad: a Lesson in Biogenesis. By W. H. Dallinger, F.R.M.S., and J. Drysdale, M.D. Monthly Micr. Journ., x. (1873) pp. 55–8.

Further Researches into the Life-history of the Monads. By W. H. Dallinger, F.R.M.S., and J. Drysdale, M.D. Read Nov. 5, 1873. Monthly Micr. Journ., x. (1873) pp. 245–55.

Further Researches into the Life-history of the Monads.—II. By W. H. Dallinger, F.R.M.S., and J. Drysdale, M.D. Read Dec. 3, 1873. Monthly Micr. Journ., xi. (1874) pp. 7–10.

Further Researches into the Life-history of the Monads.—III. By W. H. Dallinger, F.R.M.S., and J. Drysdale, M.D. Read Jan. 5, 1874. Monthly Micr. Journ., xi. (1874) pp. 69–72.

On a Simple Method of Preparing Lecture-illustrations of Microscopic Objects. By Rev. W. H. Dallinger, F.R.M.S. Read Jan. 7, 1874. Monthly Micr. Journ., xi. (1874) pp. 73–4.

Further Researches into the Life-history of the Monads. By W. H. Dallinger, F.R.M.S, and J. Drysdale, M.D. Read Jan. 7, 1869. Monthly Micr. Journ., xi. (1874) pp. 97–103.

Continued Researches into the Life-history of the Monads. By W. H. Dallinger, F.R.M.S., and J. Drysdale, M.D., F.R.M.S. Read Nov. 4, 1874. Monthly Micr. Journ., xii. (1874) pp. 261–9.

Further Researches into the Life-history of the Monads. By W. H. Dallinger, F.R.M.S., and J. Drysdale, M.D., F.R.M.S. Read April 7, 1875. Monthly Micr. Journ., xiii. (1875) pp. 185–97.

On the Existence of Flagella in *Bacterium termo*. By W. H. Dallinger, F.R.M.S., and J. Drysdale, M.D., F.R.M.S. Taken as read. Monthly Micr. Journ., xiv. (1875) pp. 105–8.

On a New Arrangement for Illuminating and Centering with High Powers. By the Rev. W. H. Dallinger, Vice-President R.M.S. Read March 1, 1876. Monthly Micr. Journ., xv. (1876) pp. 165–9.

Experiments with a Sterile Putrescible Fluid, exposed alternately to an Optically pure Atmosphere, and to one charged with known Organic Germs of extreme minuteness. By the Rev. W. H. Dallinger, Vice-President R.M.S. Read Nov. 1, 1876. Monthly Micr. Journ., xvi. (1876) pp. 288–93.

On *Navicula crassinervis*, *Frustulia Saxonica*, and *Navicula rhomboides*, as Test-objects. By the Rev. W. H. Dallinger, Vice-President R.M.S. Read Dec. 6, 1876. Monthly Micr. Journ., xvii. (1877) pp. 1–7.

Additional Note on the Identity of *Navicula crassinervis*, *Frustulia Saxonica*, and *Navicula rhomboides*. By the Rev. W. H. Dallinger, Vice-President R.M.S. Read March 7, 1877. Monthly Micr. Journ., xvii. (1877) pp. 173–8.

On the Measurement of the Diameter of the Flagella of *Bacterium termo*: a Contribution to the Question of the "Ultimate Limit of Vision" with our present Lenses. By the Rev. W. H. Dallinger, F.R.M.S. Read June 5, 1878. Journ. R.M.S., i. (1878) pp. 169–75.

On a Series of Experiments made to determine the Thermal Death-point of known Monad Germs when the Heat is endured in a Fluid. By the Rev. Dr. W. H. Dallinger, F.R.M.S. Read Dec. 10, 1879. Journ. R.M.S., iii. (1880) p. 1–16.

The President's Address. Read Feb. 11, 1885. Journ. R.M.S., 1885, pp. 177–95.

The President's Address. Read Feb. 10, 1886. Journ. R.M.S., 1886, pp. 193–207.

The President's Address. Read Feb. 9, 1887. Journ. R.M.S., 1887, pp. 185–99.

The President's Address. Read Feb. 8, 1888. Journ. R.M.S., 1888, pp. 177–85.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, Etc.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Mendelian Action on Differentiated Sex.‡—D. Berry Hart has made an interesting inquiry into the relation of Mendelian inheritance and sex. It is sometimes urged that Mendelism does not apply in normal human development, but the author attempts to show that it really does, and his argument is somewhat as follows:—

In the male and female genital tract there are present the potential organs characteristic of the developed special sex, and also traces of the opposite sex. Thus the adult human male genital tract contains not only the testes and phallus, but also the Müllerian hydatid of the testes and the prostatic utricle, the representative of the hymen; while the female genital tract has the characteristic ovaries, uterus, and vagina, but also the epoophoron and its duct, the representative of the epididymis and ductus epididymis of the male. These may be termed the potent and non-potent elements of the tract, but they may also be looked on as dominant and recessive in Mendel's sense. Thus the phallus and testes are dominant; the hydatid testes and prostatic utricle recessive; while in the same way the ovaries, uterus, and vagina are dominant, and the epoophoron recessive. All the parts making up the associated genital tract are classified in the same way, but the above part of this classification is all that is necessary for the author's argument. Weismann's terminology is used to a certain extent—viz. "determinants" for the elements in the zygote that are causal to the results or determinates in the fully developed animal.

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Proc. Roy. Soc. Edinburgh, xxix. (1909) pp. 607–18 (3 figs.). Also in extenso, Edinburgh, 1909, pp. 1–41 (3 figs.).

If the genital tract contains "determinates" which are dominant and recessive, it follows that it is an impure dominant, and that the zygote, containing causal dominant and recessive determinants, is an impure dominant of F^1. For reasons we cannot detail, the dominant and recessive genital determinants are considered as coupled—e.g. in the human species, behaving as one autonomous character. The segregation of these does not take place normally or abnormally in the human species—i.e. does not pass on to the segregation shown in peas in F^2. The question is next discussed as to the origin of the gametes (ovum, spermatozoon). The usual view of their origin from the germ or sperm-epithelium of the sexual gland is rejected, and they are considered as originating in the earliest division of the zygote, a view we owe to Owen (1849), and especially to Eigenmann, Boveri, Beard, and many other observers. This view of the continuity of the germ-cells is elaborated and termed the Owen-Weismann law for convenience, and in recognition of its two principal discoverers.

The zygote is due to the union and blending of the gametes, and the question arises as to how many gametes are necessary. The main views are: (1) male and female eggs and a male gamete; (2) single male and female gametes; (3) a sex male gamete and a non-sex male gamete with a sex female gamete and a non-sex female gamete. The second view is the usual one. The theory, however, that the human zygote is an impure dominant owing to the presence of the non-potent determinants makes it less feasible, and the author advocates the third view.

The zygote necessarily contains the determinants for the complete organism, and the gametes, combined, contain them too. The male zygote is supposed to result from the union of a sex spermatozoon and a non-sex ovum; the female zygote from the union of a sex-ovum and a non-sex spermatozoon. This will give the practical equality of the sexes.

Have we any means of allotting the unit characters to the gametes? Attention is drawn to such a source. In men, and especially in women, what are termed dermoid tumours are found, almost always in the ovary and testes. When these are solid they are termed teratomata, or embryomata, and consist of elements of all the germ layers, and practically may form the anterior part of an embryo.

Shattock has published an account of a specimen of ovarian embryoma now in the Museum of the College of Surgeons, London, which has a spinal column, limbs, peritoneal cavity, with a small coil of intestine and labia majora. The tissues are normal in teratomata.

In no specimen has evidence of the presence of genital organs been found (testes or ovary). Okhubo has published a full account of the known testicular teratomata, and confirms the structural facts as to ovarian dermoids. Many views as to the origin of embryomata have been advanced; the author adds to them by suggesting that they arise from a non-sex gamete which has retained the power of zygotic development, lost when the primitive germ-cells are reduced to gametes. He thus considers that the early zygote first divides into a propagative part and a somatic part; the latter forms the individual. The propagative part (primitive germ-cell mass) becomes the primitive germ-cells, and these are equivalent to zygotes. Normally, they are reduced to gametes, which cannot form a complete organism, but when suitably combined, as in fertilization, get the full tale of determinants a zygote needs. If a non-sex ovum or spermatozoon can form such a teratoma as Shattock's case, then we may consider that the non-sex gamete is somato-pleuric in the main, while the sex one has splanchnopleure and sex determinants. This fits in with the popular belief that in the main, the mental and bodily development is derived in girls from the father, the sex from the mother. Boys, on the other hand, take sex from the father, and bodily and mental development in the main from the mother. There is, however, an interchange of paternal and maternal characters in each case to a certain extent.

The author urges that there is evidence of Mendelian action in sex development. Mendelism does not differentiate sex, but the sex determinants are coupled and present in the sex gamete, and act as Mendelian unit characters. The segregation of the dominant and recessive sex determinants takes place in certain twins of black cattle, where the Free-martin, born with a potent bull, is really a sterile male, with the non-potent parts of the male genital tract segregated in it. The Free-martin is, therefore, an extracted recessive *quâ* its genital determinates, the potent twin an extracted dominant. This has happened from changes in the early zygote, and for this and other reasons the author denies the validity of the theory of the segregation ratio arising by combinations of the gametes.

He places the human zygote in F^1 of Mendel's scheme, the potent twin as D in F^2, and the Free-martin as R in F^2. He promises further proof on this point.

Development of the Alpine Salamander.*—H. Wunderer gives an account of researches in regard to the biology and development of the Alpine salamander (*Salamander atra* Laur.). The chief points discussed are, the time of reproduction, the duration of gestation, anomalies of reproduction, the embryonal ova and the nutritive ova, and the phylogenetic position of the form. His main conclusions are as follows: The uterus of *S. atra* is only developed as gestation proceeds, by the muscular pressure of the nutritive eggs against the caudal section of the tube-like oviduct, which thus becomes distended. Very early segmentation-stages are never found in a fully developed uterus. The Alpine salamander has a limited reproductive period, which at about 1000 metres above sea-level lasts from the beginning of June to the end of July. The reproductive period begins later with increasing altitude, thus at 1700 metres it falls at the end of June or the beginning of July. The greatest production of embryos takes place about the middle of the reproductive period. Under natural conditions at median altitudes the embryos of *S. atra* go through what Schwalbe describes as the first stage of development in six or seven weeks. Towards the end of the first year they reach the middle of the second stage, and complete it in June or the beginning of July of the second year. Birth takes place in the spring

* Zool. Jahrb., xxviii. (1909) pp. 23-78 (2 figs.).

or summer of the third year. In lower lying regions the embryos may be born late in the summer of the second year of gestation. In Alpine regions some of the embryos of the same year may not be born till the fourth year of gestation. The Alpine salamander has thus, at least in the higher parts of its range, a longer period of gestation than that occurring in any other known animal. In mountainous regions a year passes between the end of gestation and the liberation of fresh ova. *S. atra* thus usually completes its reproductive cycle in three years, so that about a third of the females will reproduce each year.

Various anomalies connected with reproduction were found. At ovulation the ovaries sometimes liberate bladder-like structures, which may be met with both in the abdominal cavity and in the oviduct. The discrepancy between the maturing of the two ovaries was sometimes so great that ovulation from both could hardly take place in the same year. Anomalies in the contents of the uterus were also found. Sometimes two embryos were found within a single envelope, and it is probably to this anomaly that the occasional occurrence of two older embryos in one uterus is to be referred. In regard to anomalies already known the author's results differ somewhat from those of previous observers. Differences in size between embryos in the later stages, leading to discrepancies in the time of birth, arise, he finds, only during the course of development of embryos of the same age; dead embryonal ova are never replaced by nutritive ova. Abnormal embryos, whether occurring alone or along with normal ones, always arise from embryonal ova.

The embryonal ovum is distinguished from the nutritive ovum by the presence of a strong, thick, gelatinous envelope; the nutritive ovum has occasionally a very thin envelope, but is more often without any. There is never even a partial development of the nutritive ova. The difference between the two forms is not due to any primary difference in the ova, but is brought about by the peculiar conditions in the uterus. Fertilisation takes place within the caudal portion of the uterus. The chief cause of the breaking down of the nutritive ova is mechanical, and is conditioned mainly by the movements of the emerging embryo.

In regard to phylogeny, Wunderer's observations lead him to regard the Alpine salamander as a direct descendant of an egg-laying Urodelan type with internal fertilisation.

Parthenogenetic Segmentation in Hen's Eggs.—A. Lécaillon* has studied this in the case of hens which have not been mated or which have been separated from a cock for a long time. Nucleated cells are seen and stages of karyokinesis. The cells and the nuclei vary much in size, and the mitosis is also variable. A few hours after laying no dividing cells are to be seen, but many nuclei are still visible. Degeneration sets in quickly.

The author† also calls attention to the interesting fact that the cells which arise by parthenogenetic segmentation of the eggs of the fowl contain attraction spheres and centrosomes.

* C.R. Soc. Biol. Paris, lxvi. (1909) pp. 1053–5.
† Comptes Rendus, cxlix. (1909) pp. 64–6.

Development of Myocardium.*—T. Kurkiewicz has studied this in chick embryos. The formative material arises from the splanchnopleure of the cranial part of the embryo. The cells form at first two "myocardial pouches" invaginated into the cœlom beneath the gut. The median walls are in contact and form a partition.

In the cavities of the myocardial pouches the endocardial primordium is paired on to the eight-myomere stage. By the sinking down of the myocardial partition the endocardial primordia are able to unite into a single tube.

The part of the splanchnopleure which becomes the myocardial primordium is at first a single layer. Two layers are soon established with quite distinct cells. The author traces the gradual differentiation in detail.

Sympathetic Nervous System of Pig.†—A. Kunz has studied the development of the sympathetic nervous system of the pig, with special attention to the question of the migration of nervous elements from the neural tube along the fibres of the peripheral nerves He finds that medullary cells migrate from the neural tube into the dorsal and ventral nerve-roots in embryos of the pig. These migrating cells are of two types: (1) elongated cells, which are to be regarded as the indifferent cells of Schaper; (2) pyriform cells, which are to be regarded as the neuroblasts. These migrating cells seem to have their origin in more or less definite regions in the neural tube. Both the indifferent cells and the neuroblasts wander peripherally, and may be traced along the spinal nerves and visceral rami into the primordia of the sympathetic ganglia. The neuroblasts, which migrate from the neural tube into the primordia of the sympathetic ganglia, develop into sympathetic neurones. Thus there is established a direct genetic relation between the sympathetic and the central nervous system. A large majority of the elongated cells which wander out from the neural tube and sensory ganglia probably enter into the formation of the neurolemma.

Regulation in Shell-Making.‡—Raymond Pearl describes a case in which the first egg laid by a pullet was very abnormal (elongated ovate pyriform) in shape. In the subsequent eggs laid there was a progressive change of shape. This change was of a regulatory character, the eggs finally coming to be normal in shape. It is shown that this progressive regulatory change follows a logarithmic curve, and the significance of this fact is discussed. The data obtained in this case are held to warrant the conclusion that the shape of the egg is determined by the muscular activity of the walls of the uterus.

Formation of Shell on Birds' Eggs.§—R. Pearl and F. M. Surface have made a series of experimental investigations with a view to determining the nature of the stimulus which causes the shell to be formed on a hen's egg. They performed an operation on hens as a result of

* Bull. Int. Acad. Sci. Cracovie, No. 6 (1909) pp. 148–91 (3 pls.).
† Anat. Record, iii. (1909) pp. 458–65 (2 figs.).
‡ Journ. Exp. Zool., vi. (1909) pp. 339–59 (1 pl.).
§ Science, n.s. xxix. (1909) pp. 428–29.

which the contents of the intestine were made to pass through the shell-gland. The result led them to conclude that the stimulus which excites the shell-secreting glands of the fowl's oviduct into activity is mechanical rather than chemical in nature, and that the formation of the shell is brought about by a strictly local reflex, and is not immediately dependent upon the activity of other portions of the reproductive system.

Ovarian Interstitial Gland in Rabbit.*—Cl. Regaud and G. Dubreuil find that if a doe be isolated the interstitial gland diminishes,—greatly in winter, less in spring. Permanent cohabitation with a virile male determines an increase in the gland, even during winter. Variations in general nutrition do not account for the changes in the gland. The sexual activity in spring and cohabitation are both associated with increased development of the gland.

Spermatogenesis of Guinea Fowl.†—M. F. Guyer has studied the spermatogenesis of the domestic form of *Numida meleagris*. Seventeen chromosomes, differing considerably in size, occur in the spermatogonia. Nine chromosomes appear for division in the primary spermatocytes. Of these, eight are presumably bivalent, the other, which is comparable to the "accessory" or "odd" chromosome of Tracheata, remains unpaired.

The odd chromosome passes undivided to one pole of the spindle considerably in advance of the other chromosomes. The result of the division of the primary spermatocyte is, therefore, that half of the daughter-cells contain eight, and half nine chromosomes.

The eight chromosomes which pass to the one secondary spermatocyte pair again to form four, which ultimately appear at the time of division in this cell. Eight of the nine which pass to the other secondary spermatocyte pair similarly, the odd one remaining unpaired. At the division of the secondary spermatocyte, the odd chromosome after lagging for some time divides longitudinally.

The divisions of the secondary spermatocytes result in the production in equal numbers of two classes of spermatids, those containing the odd chromosome and those without it. The two kinds of spermatids are visibly different, and ultimately give rise to spermatozoa which differ in size. The axial filament of the spermatozoon tail apparently arises in contact with the nucleus.

b. Histology.

Variability in Number of Chromosomes.‡—Paolo Della Valle has studied the chromosomes, especially in larval salamanders, with particular reference to their number and individuality. He finds that the number is by no means so constant as is usually said. It is variable within limits, and these are wider for the somatic cells than for the germ-cells.

Nervous System of a Deaf White Cat.§—C. Winkler has studied the nervous system of a white blue-eyed cat, which during life, though

* C.R. Soc. Biol. Paris, lxvii. (1909) pp. 348–50.
† Anat. Anzeig., xxxiv. (1909) pp. 502–13 (2 pls.).
‡ Arch. Zool, iv. (1909) pp. 1–177 (1 pl.).
§ Proc. Acad. Amsterdam Section of Sciences, xi. (1909) pp. 225–30.

most carefully observed, never reacted to acoustic stimuli. It was certainly deaf from birth, and investigation showed that it could not be regarded as more than a pathological product. It was no variety. An encephalitis, probably during intra-uterine life, had destroyed a part of the left hemisphere (not the so-called auditory radiation), and occasioned a hydrocephalus internus. Its pressure endangered the systems on the surface of the ventricles. More especially those systems were endangered that were threatened from both sides by compression, owing to their position on the border of the recessus lateralis. The stria acustica was destroyed in this way.

Eye of Birds.*—Victor Franz gives a detailed account of the macroscopic peculiarities of the eye in a large number of birds, and of the microscopic structure of the bird's eye in general. He shows how the structure is adapted in a manifold way for very rapid and precise accommodation; adaptations in many parts contribute to the one result. Several general conclusions are drawn—that the differentiation of an organ often increases with its size; that phyletically young organs show as high a degree of variability as vestigial organs. Convergence even in detail is illustrated by the resemblance between the eye of *Podargus strigioides* and that of owls.

Stomach Glands of Lizard.†—A. Arcangeli describes the structure and distribution of the glandular elements in *Lacerta muralis.*

Thyroid Gland of Gecko.‡—G. Viguier describes the minute structure of the thyroid of *Tarentola mauritanica.* There are epithelial vesicles enclosing a secretion, and between these there are blood channels lined by endothelium.

c. General.

Integumentary Glandular Organs in Anthropoids. §— August Brinkmann notes that the kind of organ that is common in Bats and Ungulates is all but unknown among Primates. Apart from the mammary glands, which the author of course excepts, the single instance hitherto known is the axillary gland in man. Brinkmann has found a similar gland in the chimpanzee and gorilla, but not in orang or gibbon.

Action of Extract of Suprarenal Capsule on the Isolated Heart.‖ A. Panella has experimented with isolated hearts of frog and rabbit, and his most general result is that the active suprarenal principle, which he calls miostenina, increases the energy and frequency of the beats.

Hibernating Racoon.¶—S. R. Williams reports that a young racoon (*Procyon lotor*) was found hibernating in a hollow sugar-tree in South-western Ohio, after a period of low temperature (20° below zero Fahr.). It had a few worn sticks in its stomach, and the intestine was

* Zool. Jahrb., xxviii. (1909) pp. 73–294 (5 pls. and 122 figs.).
† Atti Soc. Toscana Sci. Nat. Pisa, xxiv. (1908) pp. 205–17.
‡ C.R. Soc. Biol., lxvi. (1909) pp. 1064–5.
§ Anat. Anzeig., xxxiv. (1902) pp. 513–20 (6 figs.).
‖ Atti Soc. Toscana Sci. Nat. Pisa, xxiv. (1908) pp. 3–49.
¶ Ohio Nat., ix. (1909) pp. 495–6 (1 fig.).

empty. A sheet of fat from the rump and upper hind quarters weighed 416 grains, one-ninth of the total weight. The total fat amounted to 627 grains, more than one-sixth of the total weight. As the racoon curls up in the hollow tree with its nose between its hind legs and its tail over its head and shoulders, the rump and back make the least protected part of the circle. Hence the location of the heavy fat blanket in that region.

Genital Organs of Rodents.*—Lars Gabriel Andersson has made an elaborate study of the structure and development of the external genital organs and the anus in rodents, especially rat, guinea-pig, and squirrel.

Hairs in Adult Dolphins.†—W. Kükenthal refers to the usual statement that hairs are absent in adult dolphins, except in the case of the river dolphin *Inia*. But Kükenthal found twenty large "hair-roots," not of a rudimentary character, on the head of a female dolphin caught at Rovigno. Six pairs were on the upper jaw, and four pairs occurred in the frontal region. Similar "hair-roots," which did not suggest a rudimentary character, were also found on a male *Delphinus tursio*.

Types of Human Ears.‡—R. B. Bean has studied the characters of the ears in the cosmopolitan population of Manila, and he seeks to establish definite types associated with definite physical types of men.

Large Parasphenoid in Turtle.§—J. Versluys has made the somewhat surprising discovery of a large parasphenoid—a bone till recently regarded as absent in Chelonia—in the skull of an adult turtle (*Dermochelys coriacea*). It is firmly fused with the basisphenoid, but is a quite distinct bone. This is interesting in connection with the phylogeny of Chelonia, for it implies that the ancestral stock from which Chelonians sprang must have had a well-developed parasphenoid rostrum.

Pseudemydura.‖—F. Siebenrock describes an interesting Australian tortoise, *Pseudemydura umbrina* Siebenrock, which is in some ways related to *Emydura*, but serves to link the Australian to the South American Chelydidæ.

Organ of Bidder in Toad.¶—Paul Aimé and Christian Champy refer to Policard's conclusion that the removal of this organ was soon followed by the toad's death. They find that the organ may be removed with impunity, even at the time of its maximum development.

Warning Colours in Coral-Reef Fishes.**—J. Reichard has made an experimental study of the coral-reef fishes of the Tortugas region with a view to determining the biological significance of the conspicuousness which characterises many of them. He shows that this

* Arkiv f. Zool., v. (1908) pp. 1–230 (142 figs.).
† Anat. Anzeig., xxxv. (1909) pp. 8–10.
‡ Philippine Journ. Sci., vi. (1909) pp. 27–52 (10 pls. and 19 figs.).
§ Zool. Jahrb., xxviii. (1909) pp. 283–94 (3 figs.).
‖ SB. k. Akad. wiss. Wien, cxvi. (1907, rec'd. 1909) pp. 1205–11 (1 pl. and 1 fig.).
¶ C.R. Soc. Biol. Paris, lxvii. (1909) pp. 181–2.
** Publications Carnegie Inst. Washington, No. 103, pp. 257–325 (5 pls.).

conspicuousness is not a secondary sexual character, and that it serves neither for progressive nor protective resemblance, and then describes a series of experiments made to test its value as a warning character. It was shown by experiment with artificially-coloured Atherinas, which were at the same time rendered unpalatable, that the grey snapper, the commonest predaceous fish of the region, discriminates certain colours, forms associations with great rapidity, and retains these associations for a considerable time (memory). The artificially-coloured Atherinas quickly came to have a warning significance for the grey snapper, and to be avoided even when not unpalatable, although normal Atherinas were still readily eaten. Conspicuously coloured coral-reef fishes were then thrown to the snappers, in their natural environment. but at a distance from the reefs, and all the twenty-one species used were readily eaten. The investigator therefore concludes that these fishes do not possess that combination of conspicuousness with unpleasant attributes necessary to the theory of warning coloration, and that their colouring has no warning significance. Selection has not acted on their colouring or other conspicuous characters, but these are the result of internal forces. They are the result of race tendency unchecked by selection.

In the last part of the paper the author applies his conclusion to the "warning coloration" of insects. He brings evidence to show that vertebrate foes are able to discriminate between palatable and unpalatable insects without the aid of a distinguishing conspicuousness, and maintains that. since unpalatability must have preceded it, the conspicuousness cannot have been initiated by selection. The conspicuousness has been developed under immunity from selection, and it is therefore to be regarded as an expression of race tendencies, of internal forces unchecked by selection. The author proposes a theory of "immunity coloration" as a substitute for the theory of warning coloration, the former term covering all cases not attributable to selection.

Cranial Anatomy of Mail-Cheeked Fishes.*—E. P. Allis, jun., describes the skull of *Scorpæna* in detail, and with beautiful illustrations. This is the first instalment of an account of the whole cranial structure in the mail-cheeked fishes.

Archer-Fish.†—Theodore Gill gives an account of the archer-fish (*Toxotes*) and its feats. relying mainly on the observation of Zolotnitsky in 1902, but pointing out the need for corroboration.

Nuclein Material in Various Stages of Eel.‡—A. Panella finds that phospho-carnic acid is a normal component substance in the eel at all stages (after the Leptocephalus-stage)—young, adolescent, and adult. The nuclein content is at a maximum in the youngest (post-larval) stage, and decreases gradually as the animal grows older.

Nervous System of Lancelet.§—J. Boeke discusses that part of the ventral cerebral wall of *Branchiostoma lanceolatum*, which he previously

* Zoologica, lvii. (1909) lief. 3, pp. 1–72 (3 pls.).
† Smithsonian Misc. Coll., v. (1909) pp. 277–86 (3 figs.).
‡ Atti Soc. Tosc. Sci. Nat , xviii. (1909) pp. 25–30.
§ Proc. Acad. Amsterdam Section of Sciences, xi. (1908) pp. 53–9 (1 pl.).

called the "infundibular organ." Its structure and development have more resemblance to the epithelium in the saccus vasculosus of the Ichthyopsidæ, to which he applied the same name, than to the tuberculum posterius, which is still somewhat problematical. He also discusses the shape and development of the brain-vesicle.

INVERTEBRATA.

Mollusca.

a. Cephalopoda.

Memoir on Eledone.*—Annie Isgrove gives an account of "the lesser Octopus," *Eledone cirrosa*, or *Moschites cirrosa*, discussing its occurrence, habits, food, external features, internal structure, and spawning. Her work seems to us a model of what a memoir of this kind should be, and it is a welcome addition to the well-known and much appreciated series to which it belongs.

γ. Gastropoda.

Hibernation of Snail.†—Marguerite Bellion finds that the hygrometric state of the atmosphere is the essential external factor in inducing the hibernation of *Helix pomatia*; temperature is only an accessory factor. In the hibernating snail there is a decrease in weight, considerable to begin with, then slight, and finally greater again; an appreciable dehydration in the muscular and the hepatic tissue; a diminution in the fat and glycogen: an accumulation of lecithins in the liver, the muscles, and the albumen gland; an accumulation of glucose in the liver, the pedal muscle, the albumen gland, and in the blood. In the first part of the hibernation the liberation of water vapour and carbon dioxide diminishes considerably. The values of the respiratory quotients decrease continuously from the beginning to the end of hibernation. There is an accumulation of carbon dioxide in the tissues as the oxygen decreases.

Respiration of Hibernating Snail.‡—Marguerite Bellion finds that the respiratory exchanges in *Helix pomatia* are much less intense during hibernation. The amount of water vapour given off diminishes greatly at the beginning of the hibernation, and then remains almost constant. It is in the middle of the hibernation that there is a great decrease in the amount of carbon dioxide given off. It becomes almost undetectable and remains very slight on to the end of the period. The value of the respiratory quotient diminishes progressively from the formation of the operculum onwards. The amount of oxygen in the internal gas of the animal diminishes during hibernation, reaching a minimum in February, but the amount of carbon dioxide accumulates.

Action of Radium Rays on Ova of Philine.§—Jan Tur exposed the eggs of *Philine aperta* for 6–20 hours to a strong radioactive preparation, the rays passing through a thin glass plate. The segmentation

* Liverpool Marine Biol. Comm., Memoir xviii. (1909) pp. 1–105 (10 pls.).
† C.R. Soc. Biol. Paris, lxvi. (1909) pp. 964–6.
‡ Tom. cit., pp. 917–18.
§ Comptes Rendus, cxlix. (1909) pp. 439–41.

did not seem to be affected, but as the embryo began to assume a cordiform shape, the influence made itself felt. The cells became disordered and ruptured outwards. The primordia became unrecognisable. Cells were set adrift. The deformed larvæ all died without being hatched.

New Brazilian Opisthobranchs.*—F. M. MacFarland describes the following new species: *Pleurobranchus agassizii*, *Discodoris branneri*, *D. voniheringi*, *Peltodoris greeleyi*, and *Spurilla braziliana*, and also gives a full account of *Tethys dactylomela* Rang, and *T. cervina* Dall and Simpson. Particular attention is given to the nervous systems.

Arthropoda.

α. Insecta.

Accessory Genital Organs in Female Cockroach.†—L. Bordas describes in detail the left arborescent gland, which makes lime for the ootheca, the right arborescent gland, which makes a mucilage used in fixing the ootheca to some external object, and the spermotheca which consists of two tubes very unequal in size.

Thoracic Sclerites of Insects.‡—G. C. Crampton makes an important contribution to the comparative morphology of the thoracic sclerites in insects. These sclerites are much used in classification and myology, but there is a confusing lack of uniformity in the terminology employed and as to the homologies recognised. The comparative morphological study which Crampton has made is very welcome.

Burrowing Wasp Destructive of Glossina.§—F. Picard gives some account of a species of *Oxybelus*, which hunts the tsetse fly (*Glossina palpalis*) in Senegal and Nigeria.

Spermatogenesis in Acrididæ and Locustidæ.‖—H. S. Davis has made an investigation of the spermatogenesis in these two families of the Orthoptera. His paper gives a full account of spermatogenesis in *Dissosteira carolina*, with notes on points of special interest in six other species studied. His results are as follows: In all the forms studied there is a single apical cell of characteristic appearance at the distal end of each follicle. The primary spermatogonia surround and are in contact with the apical cell. The secondary spermatogonia are enclosed within a membrane formed by connective-tissue cells, the whole constituting a spermatocyst. All the spermatogonia in each cyst are the direct descendants of a single spermatogonium, which become surrounded by one or more connective-tissue cells, and are, with rare exceptions, at practically the same stage of development.

The resting nuclei of the spermatogonia vary greatly in shape, and show a marked depression on the side adjacent to the greatest amount

* Leland Stanford Junior Univ. Publications, University Series, No. 2 (1909) 105 pp., (19 pls.).
† Ann. Sci. Nat., ix. (1909) pp. 71–121 (1 pl., 18 figs.).
‡ Prac. Acad. Nat. Sci. Philadelphia, lxi. (1909) pp. 3–54 (4 pls. and 21 figs.).
§ C.R. Soc. Biol. Paris, lxvii. (1909) pp. 360–2.
‖ Bull. Mus. Comp. Zool. Harvard, liii. (1908) pp. 59–158 (9 pls.).

of cytoplasm. The autosomes of the spermatogonia vary greatly in size, and can be readily arranged in symmetrical pairs, which usually lie close together, and show constant and characteristic differences in both form and size. A monosome is always present. The oogonia contain one more chromosome than the spermatogonia, there being a symmetrical pair in place of the monosome. In the resting spermatogonia of *Steiroxys trilineata* the monosome is enclosed within a separate vesicle. During the telophase of the last spermatogonial division, the monosome, which is enclosed within a distinct vesicle, retains its compact form, and often shows a more or less distinct bipartite structure. The first stage of the primary spermatocyte is characterised by the chromatin being evenly distributed through the nucleus in a finely granular condition. Later, the chromatin collects in more or less definite masses, which in favourable cases (*Chortophaga*, *Melanoplus*) can be seen to be of approximately the same number as the autosomes of the spermatogonia. Each chromatic mass later becomes converted into a single spireme thread, composed of a single series of chromatin granules connected by linin. The spireme threads become converted into loops having a polar arrangement, each loop being composed of two homologous autosomes joined end to end. The polar loops later show a more or less distinct longitudinal split. This split, however, does not extend to the linin, but is produced by each chromatin granule dividing into two equal parts. Later the longitudinal split becomes temporarily indistinct, and may entirely disappear, while the loops open out and assume a peripheral position. In the early growth-period the monosome becomes enclosed within the nucleus, where it forms a somewhat flattened, deeply staining, often vacuolated element, closely applied to the nuclear membrane. During the later growth-period the monosome goes through a complicated development, which is to a certain extent comparable to that undergone by the autosomes during the same period. In *Stenobothrus* and *Melanoplus* the monosome divides into two dissimilar parts, which can be distinguished up to a late stage in the prophase of the first maturation division. Each polar loop of the growth-period develops into a definite tetrad during the prophase of the first division. The bivalent autosomes or tetrads show the same size relations as the autosome pairs of the spermatogonia, and are evidently formed by the conjugation of the components of each pair. In addition to the difference in volume the bivalent autosomes show constant and characteristic differences in form. In general, several more or less distinct morphological types can be distinguished, and the members of each type appear to bear a constant numerical relationship to each other.

The first maturation division is reductional, separating chromosomes which united during synapsis. The second division is equational. Individual chromosomes differ in regard to the point of insertion of the spindle fibres during mitosis, but for each chromosome this point is constant throughout the spermatogonial and spermatocyte divisions. The monosome does not divide in the first division, but divides longitudinally, and probably equationally in the second. The spermatids are dimorphic, one half containing a monosome, while the other half lack this element. The monosome remains compact for some time within the nucleus of the spermatids, but later breaks up into fine granules in the same manner as the autosomes.

In *Dissosteira carolina*, the nebenkern is not derived directly from the remains of the spindle fibres, but is probably formed chiefly from the mitochondrion. The axial filament is from the first connected with a distinct centrosome, which is applied to the exterior of the nuclear membrane. As the spermatid elongates, the nebenkern becomes converted into an envelope surrounding the axial filament. The head of the mature spermatozoon is formed entirely from the nucleus; the centrosome forms the greater part of the middle piece, while the tail is composed of a central fibre, derived from the axial filament and nebenkern, surrounded by a cytoplasmic envelope.

In *Steiroxys trilineata* the axial filament is apparently not at first connected with a centrosome, which appears in the usual position only when the axial filament is well developed. The axial filament is from the first surrounded by an envelope of doubtful origin, denser than the surrounding cytoplasm. The nebenkern migrates round the nucleus, and becomes applied to its anterior end. The head of the mature spermatozoon is formed from the nucleus and the nebenkern, the latter developing into the acrosome; the middle piece is formed chiefly from the centrosome, which divides into four parts; while the tail is composed of the central fibre derived in part from the axial filament surrounded by a cytoplasmic envelope.

In no case is there evidence that the monosome is extruded from the nucleus, nor is there evidence that the spermatids degenerate, except in rare instances. Therefore, the mature spermatozoa must be dimorphic with respect to chromatic content, although there are no visible differences either in form or volume between the two types. Throughout the entire history of the germ-cells there is strong evidence for the individuality of the chromosomes.

Oviposition in Aphelinus.*—P. Marchal describes in some detail the way in which *Aphelinus mytilaspis*, a very minute Chalcidid, lays its eggs in *Aspidiotus*—carefully exploring the body of its victim to find a suitable place, making a wound and licking it many times in succession, and showing an "individual interest" and variety in its behaviour which makes the whole performance much more than instinctive routine.

Gynandromorphs of Anergates atratulus.†—G. Adlerz describes two individuals, predominantly like males, but with wings, and on the right side with several feminine characters. One of them tried to pair with females, while males tried to pair with it. On the left side there was a well-developed male apparatus, and internally a seminal vesicle with an associated vas deferens. On the right side there were no internal organs, and the external parts were imperfect. The right tibia and tarsus were feminine in character, the left masculine. There was no trace of female gonads or of poison gland.

* Comptes Rendus, cxlviii. (1909) pp. 1223–5.
† Arkiv f. Zool., v. (1909) No. 2, pp. 1–6 (1 pl.).

Studies of Diptera.*—Ad. Lutz gives a finely illustrated account of the Tabanidæ of Brazil and adjacent states, and describes a number of new species.

Larvæ of a Fly in Earthworms.†—D. Kerlin discusses the occurrence of the larvæ of *Pollenia rudis* Fab., a common fly, in the body-cavity of *Allolobophora chlorotica* Sav. As many as four larvæ were found in one worm—they are surrounded by leucocytes, which may destroy them. Larvæ removed from a worm and placed beside the male genital orifice of another, penetrated in the course of an hour into the seminal duct, and thence into the cœlom.

Metamorphosis of Muscles in Muscids.‡—Charles Pérez finds that the exclusively larval muscles disappear entirely and quickly when pupation sets in. They exhibit phagocytosis, as Kowalevsky and Van Rees have shown. The exclusively imaginal muscles are built up during the pupa stage from myoblasts.

The author § finds that no muscle retains its architecture unchanged from larva to imago. Embryonic myoblasts, originally external to a muscle, coalesce with it and assist in changing it. The importance of these myoblasts differs in different cases. In some abdominal muscles all the middle region persists, and the myoblasts work only at the extremities. The wing muscles are due to powerful bodies of myoblasts, connected with the epidermic primordium of the wing, which divide actively, and coalesce with larval syncytial masses that are of relatively little importance in the final result.

Insects Injurious to Olives. — Orazio Comes ‖ discusses the best means of dealing with the olive fly, *Dacus oleæ*, and A. Berlese¶ enters very fully into the same subject.

Procession Moth in Galicia.**—Antonio Garcia-Varela describes the ravages of *Cnethocampa pityocampa* Cat. among the pines (*Pinus pinaster* Sol.) in Galicia, and discusses the best means of dealing with them. The importance of Ichneumon flies, Braconidæ, Chalcididæ, and other natural enemies is emphasized.

Blood of Beetles.††—A. Ch. Hollande has studied various types of beetles, and finds in the blood, besides lymphocytes and granular leucocytes, distinctive "cells with spherules." These are leucocytes, in which the granules exhibit special development, and form spherules. They arise from ordinary leucocytes, and the spherules probably contain ferments.

Cave Beetles.‡‡—René Jeannel reports on the cave-beetles he has found in France and Algiers. From 54 French caves he records 61

* Zool. Jahrb., 1909, Supp. 10, Heft 4, pp. 619–92 (3 pls.).
† C.R. Soc. Biol. Paris, lxvii. (1909) pp. 201–3.
‡ Comptes Rendus, cxlviii. (1909) pp. 1414–16. § Tom. cit., pp. 1472–4.
‖ Atti R. Ist. Incorag Napoli, vi. (1909) pp. 3–12.
¶ Tom. cit., pp. 193–224. **Bull. Soc. Españ. Hist. Nat., ix. (1909) pp. 192–4.
†† Arch. Zool. Exper., ii. (1909) p. 271–94 (1 pl.).
‡‡ Op. cit., i. ser. 5 (1909) pp. 447–532 (8 pls.).

species, 20 of which are only "troglophilous," while 41 are more or less adapted ("troglobies") to the darkness. Thirty of these 41 species are Silphidæ. From 18 Algerian caves he records 26 species—almost the same proportion as in France. Of these all are troglophilous except 3 Staphylinids, 1 of which is blind, while 2 have eyes reduced in size. The Silphidæ, so abundantly represented in Europe, do not occur in the Algerian caves. The Algerian cave-fauna seems to be young compared with that in France.

Genus Eleodes.*—Frank E. Blaisdell has published a monographic revision of the Coleoptera belonging to the Tenebrionid Tribe Eleodiini, so far as represented in the United States, Lower California, and adjacent islands. This is practically an account of the huge genus *Eleodes*, which has to be divided into numerous sub-genera.

Ferments in Larval Trichoptera.†—Xavier Roques finds three ferments in the larvæ of *Limnophilus flavicornis*—an amylose, an invertine, and a proteolytic ferment. The digestive activity is at its maximum in the larva during the period which precedes the pupa stage; it diminishes considerably, without disappearing, during the nymph stage. But the invertine, unlike the other two ferments, which are reduced to a minimum, goes on increasing.

Variations in Oxidising Ferment in Metamorphosis of Caddis-Fly.‡—Xavier Roques finds that the oxydase in the lymph and fatty body of the larva of *Limnophilus flavicornis*, which is very abundant in the later part of larval life, decreases very rapidly at the beginning of the nymphal period. In the course of this period it exhibits a renewed activity, which coincides with phenomena of pigmentation. In the last hours of the nymphal period it decreases again, and there seems to be none in the adult.

Taxonomic Characters of Gryllus.§—F. E. Lutz publishes a paper in which he applies biometrical methods to the study of the variations and correlations of certain taxonomic characters of the genus *Gryllus*. No specific entities exist in the genus which can be demonstrated by any morphological characters thus far studied. "Species" seems to be a human convention of the same sort as "genus." The describing and naming of species in the paper has for its justification convenience of reference. A large amount of correlation exists between the various taxonomic characters, and this correlation is apparent in the genus as a whole, as well as in local samples of it. Local environmental influences have an effect on the taxonomic characters, chiefly, in all probability, on the most marked of these—the length of the ovipositor. Wing-length is markedly dimorphic. Intergrades between the two conditions were not found. Each group fluctuates about its mean to an extent and in a manner almost similar to the fluctuation of the monomorphic characters. The dimorphism of the wing affects, through correlation, the size of the other organs, especially the tegmina. The organs of the short-winged

* U.S. Nat. Museum, Bull. 63 (1909) pp. 1–524 (13 pls.).
† Comptes Rendus, cxlix. (1909) pp. 319–21.
‡ Tom. cit., pp. 418–19.
§ Publications Carnegie Inst. Washington, No. 101 (1908) 62 pp.

group are more variable and slightly less correlated than those of the long-winged group. Undoubtedly short-wingedness is the newer condition, and a degeneration. The greater variability and lesser correlation may be connected with this fact, but cannot be explained by it. The two groups are within themselves built upon much the same structural plan, as shown by the regression lines. Wing-length, both with regard to the relative abundance of the dimorphs, and the length of the wing of one of them, seems to be influenced by climatic differences; but the climatic influences are often weaker than local environmental factors. A study of the variations and correlations of the genus as a whole indicated that local populations are selected examples of it, having different constants but following the same laws of relative variability and correlation of organs. "Species" within this genus is a question of fluctuating variability, and only in one organ, conspicuous but relatively unimportant, do we find a clear case of mutation.

The above are the general conclusions arrived at by the investigator: the detailed measurements on which they are based are appended to the paper in a series of ninety-three tables.

Amphibious Cockroaches.*—R. Shelford describes *Epilampra annandalei* sp. n., which can swim on the surface of the water. He has also notes on larval forms—probably of a different species—from under stones in a jungle stream. These showed an adaptation to aquatic life, previously described in similar larvæ from Borneo, namely, that the terminal abdominal spiracles are situated at the base of two tubes projecting from below the seventh abdominal tergites.

β. Myriopoda.

Taxonomy of Himantariidæ.†—J. Chalande and H. Ribaut discuss this family of centipedes, which includes forms with the following characters:—the mandibles have several pectinate blades and a dentate blade; the labrum is well developed and made of one piece; the bases of the first maxillæ are always fused. The following tribes and genera are recognised:—

I. Himantariini (*Himantarium* and *Pseudohimantarium* g. n.).
II. Haplophilini (*Himantariella* g. n., *Meinertophilus*, *Haplophilus*, and *Stigmatogaster*).
III. Bothriogasterini (*Bothriogaster* and *Polyporogaster*).
IV. Mesocanthini (*Mesocanthus*).

But the authors hint that three genera might suffice—*Himantarium*, *Himantariella* and *Stigmatogaster*.

'Vega' Myriopods.‡—Carl Graf Attems reports on the Myriopods of this famous expedition (1878). The collection includes forty-two species, of which sixteen are new, and five new genera are established:—*Kopidoiulus* and *Karteroiulus* (Protoiulidæ, Parainlinæ), *Fusiulus* (Deuteroiulidæ), *Ktenostreptus* (Spirostreptidæ), and *Orsiboe* (Siphonophoridæ).

* Records Indian Museum, iii. (1909), pp. 125–7 (2 figs.).
† Arch. Zool. Exper., i. ser. 5 (1909) pp. 197–275 (54 figs.).
‡ Arkiv f. Zool., v. (1909) No. 3, pp. 1–84 (5 pls. and 27 figs.).

γ. Prototracheata.

New Australian Peripatus.*—E. L. Bouvier describes a new and interesting species of *Peripatoides*, found at Perth, in Australia. It occupies a place apart, for it shows a strange combination of primitive characters and of characters which have undergone prolonged evolution. It has crural glands in each segment, and sixteen pairs of appendages of archaic shapes. In other ways it is modern: it has no accessory teeth on the external blades of the mandibles, the papillæ on the feet are reduced to three, the receptacula seminis are atrophied or absent.

New Peripatus from the Moluccas.†—F. Muir and J. C. Kershaw describe *Peripatus ceramensis* sp. n. from Western Ceram. It is the first taken in the Moluccas, and appears from the female characters (for all the sixty-three specimens belonged to this sex) to be very distinct. In the minute size of the eggs and in its mode of development and giving birth (one young one at a time, apparently alternately from each uterus, at intervals of about a couple of weeks) it approaches the Neotropical group, but it is quite distinct in all other characters, such as number of legs, position of vagina, shape of papillæ, and number of pads on the legs. In these latter characters it comes nearer to the South African and Australian species, but the bilobate ovarian chamber with the single duct leading from it places it quite apart. It will be of interest to see if Papuan species, when found, will agree with this Ceram form.

δ. Arachnida.

Spiders of Morocco.‡—Eugène Simon reports on a collection of spiders made by M. de la Escalera in Morocco—a region which has not been much explored in this connection. Of the 110 species, 48 occur also in Algeria and S.E. Europe, 20 in Algeria only, 9 in Algeria and and Egypt, 3 in Madeira and the Canaries, 1 (*Scytodes major* E. S.) in Senegal, 1 (*Runciniopsis flavida* E. S.) in Tropical Africa, 4 are almost cosmopolitan, and 24 are peculiar to Morocco.

Harvest Mites on Man.§—L. Bruyant finds that the larva of *Trombidium gymnopterorum* is not really a parasite of man; it is restricted to Aphides. In many parts of France the larva of *Tr. inopinatum* occurs on man, as also on mole, water-shrew, cat, hare, partridge, etc. The eggs of *Tr. holosericeum* developed into larval forms identical with *Allotrombidium striaticeps*, and this name should now disappear. The larva *Tr. holosericeum* occurs also on various Diptera, chickens, ermine, and cat.

Trombidium and its Allies.||—P. Verdun points out that Oudemans defines the genus *Allotrombidium* by a larval character (two cephalothoracic knobs), whereas Berlese established it in reference to an

* Comptes Rendus, cxlviii. (1909) pp. 1292–4.
† Quart Journ. Micr. Sci., liii. (1909) pp. 737–40 (1 pl.).
‡ Mem. R. Soc Españ. Hist. Nat., vi. (1909) pp. 1–43.
§ C.R. Soc. Biol. Paris, lxvii. (1909) pp. 207–9.
|| Tom. cit., pp. 244-6.

adult character (a plumose tarsal pulvillus). Berlese's definition must be retained, and the genus *Trombidium* may be divided into two sub-genera, *Eutrombidium* Verdun (= *Allotrombidium* Oudemans) and *Heterotrombidium* Verdun (= *Trombidium* Oudemans).

Oribatoidea of Illinois.*—Henry E. Ewing describes thirty-three species, of which twelve are new. Diagnostic keys are given, and there is a useful introduction to the study of this group of mites.

Eastern Pacific Pycnogonids.†—Leon J. Cole reports on the Pycnogonids taken by the 'Albatross' in 1904 in the Eastern Pacific. The collection consisted of two specimens of *Ascorhynchus agassizii* Schimkewitsch, which is very near *A. glaber*; an immature specimen of *Colossendeis gigas* Hoek; and three specimens of *C. cucurbita* sp. n., which is closely allied to *C. gigas*, but has the proboscis with an upward curve and the fourth joint of the palp longer than the second. Attention is directed to the curious capsules which occur attached to the legs of both sexes in *Colossendeis*. It is a singular fact that the usual external egg-masses appear to be unknown in this genus, and though Hoek discusses the possibility that the capsules may represent egg-masses, he regards this as improbable.

ε. Crustacea.

Regeneration of Antennæ in Palæmon olfersi.‡—Ch. Gravier describes a specimen of this fresh-water prawn which showed the antennæ in process of regeneration.

Land Isopods of Lundy Island.§—Bruce F. Cummings collected 11 species, 2 of which, *Cylisticus convexus* and *Trichoniscus pygmæus*, have not yet been taken in the adjacent area of North Devon. A handsome yellowish variety of *Oniscus asellus* is noted.

Indian Barnacles.‖—Nelson Annandale gives an account of the Indian pedunculate Cirripedia in the family Lepadidæ. He divides the Pedunculata into Pollicipedidæ, Iblidæ, and Lepadidæ, and the last into four sub-families:—Oxynaspidinæ, Lepadinæ, Pœcilasmatinæ, and Alepadinæ. He deals with convergence, variation, and distribution in the Lepadidæ, and gives a systematic account of the Indian species. In discussing the œcology of *Dichelaspis*, he notes that there is no evidence that even the internal hangers-on are detrimental to the crustaceans in whose gill-chamber they live. They may, perhaps, aid in respiration, and in getting rid of small intruding organisms. The weight of external epizoic forms must often be great. More than 600 specimens of *D. grayi* were attached to a single snake, and the number of individuals of *D. warwickii* attached to a single crab is often as great. They may help to mask bottom-haunting crabs. In any case, it is impossible to regard the species of *Dichelaspis* as actual parasites.

* Bull. Illinois State. Lab. Nat. Hist., vii. (1909) pp. 337–89 (3 pls. and 5 figs.).
† Bull. Mus. Comp. Zool. Harvard, lii. (1909) pp. 185–92 (3 pls.).
‡ Ann. Sci. Nat., ix. (1909) pp. 123–7 (2 figs.).
§ Ann. Nat. Hist., iv. (1909) pp. 319–20.
‖ Mem. Indian Mus., ii. (1909) pp. 61–137 (3 pls.).

'Siboga' Cirripeds.* — P. P. C. Hoek notes that the 'Siboga' Expedition in the Malay Archipelago obtained 108 species, of which 68 were new, and 50 were from the deep-sea. The 'Challenger' obtained in all 78 species, of which 60 were new, and 56 from the deep-sea. Both collections show that after all only two genera, *Scalpellum* and *Verruca*, in deeper water, are represented by many species. The other genera in deep water are represented by few species. For some deep-sea species of *Scalpellum* it has been shown that they produce a few relatively large eggs, and have an abbreviated metamorphosis; whereas several genera of Cirripeds, and those of the deep sea in the first place, are spread over the whole surface of the earth; the species of Cirripeds, and especially the deep-sea species, have a very local distribution. To a certain extent, it is shown that deep-sea Cirripeds have an archaic character.

Ascidicolous Copepods.† — E. Brément reports on the Copepods which he found inside Ascidians at Banyuls-sur-Mer. He describes four new species: *Bonnierilla arcuata*, *Botryllophilus brevipes*, *B. banyulensis*, and *Aplostoma banyulensis*.

Annulata.

Spermatogenesis in Earthworm.‡—E. Hesse finds some interesting peculiarities in *Lumbricus terrestris* and *Pheretima rodericensis*. The spermatocytes of the first order are not readily distinguished from the first order of spermatogonia. The first reduction-division is followed by a resting stage. At each division part of the cytoplasm is pushed towards the centre of the spermatic follicle, and goes to form the blastophore.

The nucleus of the spermatid passes through a phase of pseudo-metamerisation, and elongates temporarily till it is much longer than the head of the ripe spermatozoon. During the shortening the staining reactions of the chromatin change entirely. The basophil granules disappear; only an acidophil cylinder is left to form the head.

The idiozome does not form the acrosome or tip, but occurs at the base of the tail as part of the middle piece, and forms, along with mitochondria, a curious transitory structure described by Depdolla.

When the spermatozoa are ripe, the external zone of the blastophore becomes very fluid, and allows them to go free. The blastophore breaks up into cytoplasmic spheres, which are devoured by phagocytes.

New Marine Oligochæt.§—Umberto Pierantoni describes *Paranais elongata* sp.n. from the Gulf of Naples, and revises the other three species of this interesting genus. The diagnosis of the genus reads: Setæ in four groups in each segment uniformly forked and sigmoid; an intestinal enlargement in the form of a stomach in the 8th segment; testes in the 9th segment; ovaries in the 10th; spermothecæ in the 5th.

* Proc. Acad. Amsterdam Section of Science, xi. (1908) pp. 110–16.

† Arch. Zool. Expér., i. ser. 5, Notes et Revue, No. 3 (1909) pp. lxi.–lxxxix. (14 figs.).

‡ Op. cit., x. (1909) pp. 411–16 (2 pls.).

§ MT. Zool. Stat. Neapel, xix. (1909) pp. 445–58 (1 pl.).

Paraonidæ.*—Attilio Cerruti gives a full account of *Aricidea jeffreysii* (M'Intosh), and describes two new species of Paraonidæ (Levinsenidæ)—viz. *Paraonis* (*Paraonides*) *neapolitana* and *Paraonis paucibranchiata*. A useful key to the family is given, and the distribution is discussed.

Modifications of Earthworm's Structure Due to Nematodes.†—Luigi Cognetti de Martiis describes the remarkable alteration of the structure of the spermothecæ of *Dichogaster itoliensis* (Michaelsen)—an earthworm from Ruwenzori—owing to the presence of larval nematodes.

Polychæt Larvæ.‡—F. H. Gravely gives an account of pelagic larvæ of Polychæts which he obtained at Port Erin. He deals especially with the metatrochophore and nectosoma stages, and gives a table for their identification which will be very useful to students of Plankton. In two or three cases (*Polynoë, Chætopterus*) he has been able to study the trochophore.

Ciliated Organs of Hirudineæ.§—R. Loeser has made an investigation of the ciliated organs of the Hirudineæ with special reference to the question whether the space into which the funnels open is to be considered as part of the body-cavity, or of the circulatory system, and whether the funnels have direct communication with the nephridia, which open to the exterior. The circulatory system of the Hirudineæ corresponds in general to that of the Chætopods. The dorsal and ventral blood-vessels are the only true vessels present, and even these may be replaced by sinuses, like those of the Gnathobdellidæ. The lateral blood-paths are always remains of the body-cavity. The author gives a detailed account of his study of three families. In the Glossiphonidæ, where the segmentally disposed, ciliated organs consist essentially of a ciliated funnel and a capsule to the wall of which it is attached, he found that the capsule was a phagocytic organ communicating with the body-cavity, and transferring its waste products to the nephridia by osmosis. In the Herpobdellidæ the ciliated organs give rise to blood corpuscles, and in abnormal cases these may take on a lymphoid character. The products of excretion are carried to the nephridia through the botryoidal vessels, which are particularly abundant about its glandular portion. In the Hirudinidæ also, the ciliated organs are in direct communication with the circulatory system, and give rise to blood-cells. In all three groups, therefore, the ciliated organs are what Cuénot called agglutinating, phagocytic organs, and with these occur ciliated cells, which all develop in a similar manner in association with the connective tissue. Physiologically these ciliated organs suggest the "urns" of the Gephyrea, but their origin is restricted to a definitely localised area, and they have not the power of detaching themselves.

Chætognatha of Black Sea.‖—L. A. Moltschanoff reports *Sagitta bipunctata* Q. G., *S. euxina* sp. n., and *Spadella parvula* sp. n. The genus

* Mt. Zool. Stat. Neapel, xix. (1909) pp. 459–512 (2 pls. and 10 figs.).
† Atti R. Accad. Sci. Torino, xliv. (1909) pp. 699–706 (1 pl.).
‡ Liverpool Marine Biol. Committee Memoirs, xix. (1909) pp. 1–79 (4 pls.).
§ Zeitschr. wiss. Zool., xciii. (1909) pp. 1–63 (3 pls.).
‖ Bull. Acad. Imp. Sci. St. Petersbourg, vi. (1909) pp. 887–902 (7 figs.).

Spadella includes the most primitive Chætognaths. Some account of the minute structure is given. The author is entirely opposed to Günther's attempt to link Chætognatha and Molluscs, and also to the view that they have affinities with Nematodes. He regards them as related to Annelids.

Chætognatha of Pacific-Boreal Sub-region.*—P. Galzon describes *Sagitta lævis* sp. n., *S. longicauda* sp. n., *S. japonica* sp. n., *S. elegans* Verrill, *S. glacialis* Moltsch, and a doubtful *S. flaccida* Conant (= *S. inflata* Grassi ?). In a detailed table he compares all the known species.

Nematohelminthes.

Chromosome Differentiation in Ascaris megalocephala.†—John H. Schaffner corroborates Montgomery's results as to the definite individuality of the chromosomes in the ova of this Nematode. Thus, in the first two cleavage divisions, the chromosomes appeared as two longer and two shorter bodies, and there is a rather constant difference between the pair of smaller chromosomes, one of which is now known to be a maternal, and the other a paternal chromosome.

New Filaria in a Lemur.‡—C. Mathis and M. Leger describe *Filaria sergenti* sp. n. from *Nycticebus tardigradus*. Adult males and females were found in the walls of the peritoneal cavity and on the mesentery. The embryos are sanguicolous.

Eustrongylides and Hystrichis.§—L. A. Jägerskiöld discusses and revises these two genera, which are represented by numerous species parasitic in birds. Four new species of *Eustrongylides* and three of *Hystrichis* are described.

Platyhelminthes.

Entozoa of British Fishes.‖—W. Nicoll continues his studies on the parasites of British fishes. He gives a useful list of fishes, with the entozoa they contain, and with an indication of the part infected and the number present in one fish. He deals in particular with *Podocotyle atomon* Rud., *Lebouria alacris* Lss., *Dihemistephanus lydiæ* Stoss., *Zoogonus rubellus* Olsson, *Lecithaster gibbosus* Rud., and *Gasterostomum triglæ* v. Ben.

Japanese Schistosomiasis.¶—J. Tsuchiya describes a new human disease due to the Trematode *Schistosoma japonicum*, which occurs in the portal vein and its tributaries. The parasite also occurs in cat and dog. The progress of the disease is very slow—it may go on for twenty or thirty years. Infection is probably through impure drinking-water.

* Zool. Jahrb., xxviii. (1909) pp. 1–22 (1 pl. and 2 figs.).
† Ohio Naturalist, ix. (1909) pp. 506–8 (9 figs.).
‡ C.R. Soc. Biol. Paris, lxvii. (1909) pp. 179–81.
§ Nova Acta R. Soc. Sci. Upsala, ii. ser. iv. No. 3 (1909) pp. 1–48 (5 pls. and 12 figs.). ‖ Ann. Nat. Hist., iv. (1909) pp. 1–25 (1 pl.).
¶ Virchow's Archiv. f. Pathol. Anat., Band 193 (1908) pp. 323–69 (1 pl.).

Conditions of Development in Paragonimus.* — P. E. Garrison and R. Leynes have experimented with the miracidium of the lung-fluke. Temperatures above 15° C. are required for the development of the ova, but temperatures as low as 10° do not impair their vitality. Direct sunlight is fatal, and light is not necessary to the development of the egg to the miracidial stage. Salt solutions are unfavourable, and above 1·5 p.c. fatal to the development. Desiccation even for a few moments is fatal, and the ova cannot be disseminated except in water.

Nitzschia.† — F. S. Monticelli discusses the tristomid Trematode *Nitzschia elegans* Nitzsch, which occurs in the branchial cavity of the sturgeon.

Hermaphroditism in a Nemertean.‡ — M. Oxner describes the reproduction in *Œrstedia rustica.* He does not agree with Joubin, who discovered and described it, in regarding this form as having the sexes separate. His investigation of 750 specimens in different months showed that the form produces throughout the whole year eggs and sperms at the same time. It has a very complicated perennial cycle of periodic reproduction. The author attributes the occurrence of hermaphroditism—rare among Nemerteans—in *Œrstedia rustica* to the special and very abundant nourishment afforded by the débris of the Ascidian *Cynthia rustica*, on which it feeds. It is to this diet that the bright red colouring of the species is due.

Incertæ Sedis.

Attachment of Brachiopods.§ — N. Yakowlew discusses the different modes of attachment in Brachiopods—especially Spiriferacea and Terebratulacea—in relation to classification. Individuals differ in attachment, and distinctions of shell-shape result, which cannot be regarded as of specific value. The type of the genus *Cyrtis* (*C. exporrecta* Dalm.) is synonymous with *Spirifer plicatellus*, the presence in *Cyrtis* of a pedicle opening in the pseudodeltidium being inconstant. In fact, *C. exporrecta* represents the individuals of *Spirifer plicatellus*, differing primarily in the growth of an elevated area, and the correlative appearance of a circular opening in the pseudodeltidium.

Metamorphosis of Alcyonidium mytili.‖ — A. Zschiesche finds that sexually mature zoœcia occur at almost every time of year. The time for free larvæ varies a good deal. Smooth surfaces are preferred for attachment. The "pyriform organ" is used for orientation on the substratum.

The fixation and the subsequent metamorphosis is described in detail, the following points receiving special attention: the evagination of the vestibulum; the extension of the dorsal larval region, and the deformation of the ciliated wreath; the coalescence of the margin with the plate of attachment; the invagination of the dorsal disc, and the

* Philippine Journ. Sci., iv. (1909) pp. 177–83.
† Atti R. Ist. d'Incorag. Napoli, vi. (1909) pp. 141–62 (1 pl.).
‡ Comptes Rendus, cxlviii. (1909) pp. 1633–5.
§ Mem. Com. Geol. St. Pétersbourg, xlviii. (1908) pp. 1–32 (2 pls.).
‖ Zool. Jahrb., xxviii. (1909) pp. 1–72 (5 pls. and 3 figs.).

subsequent formation of an entirely closed sac; the breakdown of the larval organs; and the partial absorption of the muscle-fibres by phagocytes.

Echinoderma.

Deep-sea Starfishes.* — René Koehler reports on the deep-sea Asteroidea collected by the 'Investigator' in the Indian Ocean. The collection includes at least thirty new species and five new genera—*Johannaster*, *Philiaster*, *Sidonaster*, *Circeaster*, and *Lydiaster*.

The genera *Circeaster* and *Lydiaster* are very specialised members of the family Antheneideæ; *Johannaster* stands by itself among the Plutonasterideæ; the other two new genera are less specialised, but exhibit curious combinations of characters.

Statocysts of Synaptids.†—Siegfried Becher has made observations on these organs in living specimens of *Leptosynapta bergensis*, and finds evidence that they serve to make the animal aware of the position of its body and of its movements.

Non-Muscular Articulations in Crinoids.‡—A. H. Clark discusses this difficult subject. "The non-muscular articulations in the crinoid arm, synarthries, or bifascial articulations, and syzygies, have an entirely different effect upon the arm structure than have articulations possessing muscle bundles, straight or oblique muscular articulations." He contrasts the two modes of articulation in detail. He is convinced that a detailed and careful study of the articulations and articular faces in the fossil crinoids is one of the best lines of procedure in the elucidation of their systematic relations.

Crinoids of Tennessee.§— Elvira Wood has made a critical summary of Troost's unpublished manuscript (1849) on the Crinoids of Tennessee —a valuable monograph, which has had a curious history.

Cœlentera.

Revision of Lamouroux's Collection of Hydroids.‖— Armand Billard has revised the collection in the Botanical Institute at Caen, and done the useful service of indicating what the various types would be called nowadays.

New Leptomedusæ.¶—H. B. Torrey reports on a collection from the San Diego region, consisting of eleven species, all new except one. Two new genera are required—*Scrippsia*, which is distinguished from its nearest relative *Polyorchis* by the gastric peduncle and the absence of pinnately arranged branches of the radial canals distal to the gonads, and *Tiaropsidium*, which is near *Tiaropsis*, but with tentacles of two kinds.

* An Account of the Deep-sea Asteroidea collected by the Royal Marine Survey Ship 'Investigator.' Calcutta, 1909, pp. 1–143 (13 pls.).
† Biol. Centralbl., xxix. (1909) pp. 413–25 (12 figs.).
‡ Amer. Nat., xliii. (1909) pp. 577–87 (14 figs.).
§ U.S. Nat. Museum, Bull. 64 (1909) pp. 1–159 (15 pls.).
‖ Ann. Sci. Nat., ix. (1909) pp. 307–37 (10 figs.).
¶ Univ. California Publications (Zoology) vi. (1909) pp. 11–31 (11 figs.).

New Medusa.*—Henry B. Bigelow describes *Sibogita nauarchus* sp. n., a form of much interest, since it belongs to the interesting family Bythotiaridæ Maas, which has morphological relations on the one hand to the Tiaridæ, and on the other to the Williidæ. From the two previously known species of *Sibogita* this new form may be readily distinguished by the presence of an apical depression of the ex-umbrella, as well as by the permanently blind terminations of the centripetal canals.

Relationship of Scyphomedusæ and Anthozoa.†—E. Hérouard find that a particular kind of cellular investment, different from that of the general enteron, occurs on the pharynx and gastric filaments of Scyphistoma and Medusa, and that exactly the same kind of differentiated epithelium occurs on the gullet of Anthozoa. This may be taken as part of the justification of the relationship implied by the term Scyphozoa.

Pelagic Sea-Anemone without Tentacles.‡—Nelson Annandale obtained on the Orissa beach of the Bay of Bengal a number of small, more or less globular bodies, which expanded into sea-anemones without tentacles. Although none of the specimens had gonads, they are probably not larval forms, since the number of mesenteries is large. Annandale calls the animal *Anactinia pelagica* g. et sp. n., and gives the following diagnosis :—Pelagic Cerianthidea without tentacles or a protective sheath. The musculature of the column as in the Cerianthidæ. Mesenteries twenty-four or more; the membranous part of each mesentery strongly developed and forming in cross-section a protrusion directed away from the ciliated groove. Acontia, but no (?) cinclides, present. Column conical when fully expanded, the aboral pole being pointed. The external surface smooth, feebly ciliated. Ectoderm richly armed with nematocysts at every point. The ciliated groove of great extent relative to the stomodæum. The mesenteries at both ends of the stomodæum very short. No foramina in the mesenteries.

Dendroid Graptolites.§—Ray S. Bassler gives an account of the order Dendroidea, based partly on the unpublished work of Gurley, and partly on his own studies. He deals with numerous genera, such as *Dendrograptus*, *Callograptus*, *Ptilograptus*, and *Dictyonema*.

Porifera.

South African Freshwater Sponges.‖—Nelson Annandale describes *Spongilla ambigua* sp. n. from Natal—a sponge which exhibits close affinities, especially in the structure of its gemmules, to the group represented by *S. carteri* Bowerbank, and *S. nitens* Carter, but has its gemmules grouped as in *S. fragilis* Leidy. A new subgenus *Stratospongilla* is established with the following diagnosis : Gemmules covered

* Bull. Mus. Comp. Zool., lii. (1909) pp. 195–210 (1 pl.).
† Comptes Rendus, cxlviii. (1909) pp. 1225–7.
‡ Records Indian Museum, iii. (1909) pp. 157–62 (1 pl.).
§ U.S. Nat. Museum, Bull. 65 (1909) pp. i.–ix. and 1–76 (5 pls. and 91 figs.).
‖ Zool. Jahrb., xxvii. (1909) pp. 559–70 (3 figs.).

with one layer or two or more layers of microscleres lying parallel or nearly parallel to the chitinous coat and embedded in a dense chitinoid substance. No air-chambers; granular layer absent or imperfectly developed. Free spicules, when present, amphioxous or amphistrongylous. The type of this subgenus is *Spongilla bombayensis* Carter, and specimens were got in Natal by Professor Weber. Another sponge from near Oudtshoorn, Cape Colony, is referred to *Ephydatia fluviatilis*, var. *capensis* Kirkpatrick.

New Freshwater Sponges.*—Nelson Annandale describes *Spongilla travancorica* sp. n., in the subgenus *Euspongilla*, distinguished from its allies by its adherent gemmules with (usually) multiple apertures and rough external surface. He records *Tubella pennsylvanica* Potts, from India, and establishes a new genus *Pectispongilla*, which differs as regards its gemmule spicules from any form hitherto described, for they have the armature of the extremities bilateral instead of radial. The species *P. aurea* has a deep golden colour.

Poterion, a Boring Sponge.†—G. C. J. Vosmaer points out that the structure of *Poterion* closely resembles that of the so-called *Osculina polystomella*, which is nothing but the free form of a boring sponge (*Vioa viridis*), which is a modification of the very variable *Cliona celata*. It is certain that *Poterion* must be placed in the same group as *Cliona*.

Merlia and its Encrusting Sponge.‡—R. Kirkpatrick discusses the enigmatical organism known as *Merlia normani* Kirk, the structure of which is, in some respects, like that of a Cœnothecalian coral, in some respects like that of *Monticulipora*. On specimens obtained at Porto Santo the author found a new silicious sponge, which he names *Noronha scalariformis* g. et sp. n. The diagnosis of the genus reads: "Desmacidonidæ with a skeleton formed of more or less separate bundles of tyles and raphides. Microscleres in the form of oval rings."

Philippine Sponges.§—Alven Seale gives a short, finely illustrated account of the kind of sponges—mostly species of *Euspongia*—fished in the Philippines. He discusses their preparation for the market and their cultivation. It is pointed out that artificial propagation works well. Cakes of about 5 cm. are placed on a thick copper wire about 4 cm. apart, the wire being fastened to a stake at each end, and about 15 cm. from the bottom. Within a day or two the sponges fix, and they grow into better shapes than those growing naturally. Slips planted in Florida reached a marketable size in less than two years.

Protozoa.

Conjugation in Acinetæ.‖—B. Collin has observed in *Ephelota gemmipara* the conjugation of a microgamete with a macrogamete as in Vorticellids. The male gamete seems to arise by a special kind of

* Records Indian Museum, iii. (1909) pp. 101–4 (1 pl.).
† Proc. Acad. Amsterdam Section of Sciences, xi. (1908) pp. 37–41.
‡ Ann. Nat. Hist., iv. (1909) pp. 42–8.
§ Philippine Journ. Sci., iv. (1909) pp. 57–64 (9 pls. and 4 figs.).
‖ Comptes Rendus, cxlviii. (1909) pp. 1416–18.

budding. In other Acinetæ, the author has observed isogamous conjugation, both total and partial. The divergence of Acinetæ from the stock of Peritricha probably occurred before total conjugation had become the rule in the latter.

Dimorphism of Ophryodendron.*—C. H. Martin, continuing his observations on Acinetaria, publishes a paper on the dimorphism of *Ophryodendron*, the only free-living Acinetarian in which the occurrence of two different reproductive forms in the same species has been observed. *Ophryodendron* is a somewhat aberrant Acinetarian frequently found as an external parasite on Hydroids, and also, though more rarely, on Crustaceans. It occurs under two remarkably different forms: (*a*) a proboscidiform individual, characterised by the more or less pyriform shape of the body, by the absence of a stalk (present, however, in some forms), and by the presence of a long, very contractile proboscis with rows of tentacles. (*b*) A vermiform individual characterised by its elongated, cylindrical body, by the presence of a long solid stalk which passes into the posterior end of the body, and by the absence of a proboscis. The investigator describes both forms of individual in *O. abietinum*, and he also discusses the feeding of *Ophryodendron*, with notes on nematocysts in some other Protozoa, the external budding, and the ciliated buds. He finds that *O. abietinum* is a true ectoparasite of the hydroid to which it is attached, and its contained nematocysts are derived from its host. This holds good also for *O. sertulariæ*. *Ophryodendron* is a true dimorphic form, the proboscidiform individual giving rise by a process of external budding to a vermiform individual of quite different structure. Both forms of individual can give rise to ciliate embryos. The ciliate embryos of the proboscidiform individuals develop on fixation into young proboscidiform individuals. It is probable that the ciliate embryos of the vermiform individuals also develop into proboscidiform individuals.

Hæmamœba in a Bird.†—A. Laveran and A. Pettit describe *Hæmamœba melopeliæ* sp.n. in *Melopelia leucoptera*, a bird related to the turtle-dove. It closely resembles *H. majoris* from a tomtit.

New Trypanosome in a Bug.‡—E. Chatton describes *Leptomonas agilis* sp.n. in a bug, *Harpactor iracundus* (one of the Pentatomid Hemiptera), living on *Sisymbrium polyceratum*.

Intestinal Parasites of Larval Tipulid.§—L. Léger and O. Duboscq have found no less than four protist parasites, at least two of which are new, in the intestine of a larva of *Ptychoptera contaminata*. They first describe a Gregarine, which from the form of the epimerite, the frequent occurrence of a nucleus in the protomerite, and other characters, they place in the genus *Pileocephalus* as *P. striatus* sp. n. They describe at length the effect of the parasite on the cells of the intestinal epithelium.

* Quart. Journ. Micr. Sci., liii. (1909) pp. 629–64 (1 pl.).
† C.R. Soc. Biol. Paris, lxvi. (1909) pp. 952–4 (13 figs.).
‡ Tom. cit., pp. 981–2.
§ Bull. Acad. Roy. Belg., viii. (1909) pp. 885–902 (4 pls.).

The cells attacked show enormous functional hypertrophy and mechanical deformation, but do not subsequently atrophy, nor do their nuclei degenerate. A Microsporidian, *Gurleya francottei* sp. n., occurs in large numbers in the same region of the alimentary canal as the Gregarine, but the two parasites occupy sharply separated zones, and seem to be mutually exclusive. In the microsporidial zone almost all the cells are crowded with the parasites. The cells become enormous and their nuclei hypertrophy: the apparent hypertrophy of the cell is purely mechanical, the parasites coming to occupy the place of the disappearing cytoplasm. The parasite multiplies by schizogony; pansporoblasts were also found which give rise to four spores each. The authors also record *Crithidia campanulata* Léger, situated near the malpighian tubules. Free flagellate forms are described, and also "formes grégariennes," often of peculiar bell shape. This bell shape is due in large part to flattening of the parasite against the intestinal wall in places where it is exposed to the alimentary current. Flagellates attaching themselves in the shelter of folds retain their original orientation. In the posterior region of the mid-intestine numerous long Spirochætes were observed attached to the surface of the epithelium. These Spirochætes are very like, and are possibly identical with those described by Léger in *Chironomus*. The appearance they present is not unlike that of a close coating of cilia, and Vignon made the mistake of citing this as a case of vibratile cilia in Arthropods.

New Trypanosomid in a Nycteribiid.*—E. Chatton describes and figures the first Trypanosomid (*Crithidia nycteribiæ* sp.n.) recorded from the intestine of a Nycteribiid. He found it in *Cyclopoda sykesi* Woodward, parasitic on bats (*Pteropus medius*) from India. Chatton describes only the adult stages of the flagellate, which, with its undulating membrane and its blepharoplast situated against the anterior border of the nucleus, agrees with Patton and Strickland's recent diagnosis of the genus *Crithidia*. He regards it as a true parasite of the insect, the bat's blood containing no forms that could be connected with it. While admitting the convenience of the distinctions drawn by Patton and Strickland between the genera *Crithidia* and *Herpetomonas*, Chatton considers that their classification is based on points too variable to be used as generic distinctions. He argues that the development of an undulating membrane depends on the viscosity of the surrounding medium, and that the position of the blepharoplast may be altered by the mode of fixation. Furthermore, Herpetomonads may be *Crithidia*-like in certain stages of their development, and *Trypanosoma lewisi* takes on the aspect of a *Herpetomonas* in cultures. Certain Herpetomonad-like forms, e.g. *Leptomonas agilis* Chatton, are drawn out anteriorly. The author thinks it necessary to base the classification of these organisms on characters less recently acquired, and less subject to variation with the surrounding medium. With Alilaire, he has, therefore, revived the genus *Leptomonas* Kent, for forms without a rhizoplast and with one flagellum; *Herpetomonas sensu stricto* has a long rhizoplast, and two flagella united to one another.

* C.R. Soc. Biol. Paris, lxvii. (1909) pp. 42–4 (10 figs.).

Hæmatozoa in Guiana.* — E. Brimont describes some Hæmogregarines from a tortoise and several snakes, a species of *Hæmoproteus* in a bird of prey (*Urubitinga*), and Trypanosomes in another bird (*Catharista*). Trypanosomes in the agouti and a monkey, Trypanosomes, along with *Endotrypanum schaudinni*, in the two-toed sloth, and species of *Microfilaria* in four mammals.

Intestinal Flagellates of Amphibians.†—A. Alexeieff has notes on the occurrence of *Hexamitus intestinalis* Duj. (*Octomitus dujardini* Dobell), *Octomitus* sp., *Trichomonas batrachorum*, *Bodo lacertæ*, *Monocercomonas bufonis*, *Giardia agilis*, *Treponema agilis*, all in Amphibians indigenous to France. In frog tadpoles he found a new and large form *Macrostoma caulleryi* g. et sp. n.

Spirochæts of African Fowls.‡—E. Brumpt records *Spirochæta nicollei* sp. n. from Tunisian poultry. Three other species are known: *S. gallinarum* Stephen and Christophers (carried by *Argas persicus*) from Somaliland, etc., *S. neveuxi* Brumpt, from Senegal, and *S. anserina* from the Caucasus.

Alleged Sporozoa.§—L. Léger and O. Duboscq discuss the alleged Sporozoon, *Rhabdospora thelohani* Laguesse, said to be common in many fishes, and point out that a rod-like or rhabdite arrangement of secretions in glandular cells has been mistaken for the presence of intracellular parasites.

Microsporidian inside Gregarine.‖—L. Léger and O. Duboscq describe *Perezia lankesteriæ* g. et sp. n., a Microsporidian which infests the Gregarine *Lankesteria ascidiæ* Lank. usually found in the intestine of *Ciona intestinalis*. The Microsporidian is not found in the tissues of the Ascidian; it occurs only in the Gregarines that are free in the gut. Each individual gives rise to a single pansporoblast with two spores.

Sarcosporidian in Gecko.¶—A. Weber amplifies Bertram's description of *Sarcocystis platydactyli*, which occurs in the muscles of the gecko.

Hæmogregarines in Snakes.**—A. Laveran and A. Pettit have found Hæmogregarines in *Pituophis melanoleucus* and two other Mexican snakes. They describe in particular *Hæmogregarina pituophis* sp. n. The cysts of these snake parasites show remarkable resistance; their membrane is very impermeable: some were found in good condition in the rotten liver of a snake that had been dead for twenty days.

Hæmogregarine of Python.††—A. Laveran and A. Pettit describe *Hæmogregarina sebai*, very abundant in the blood of *Python sebai*, from Senegal.

* C.R. Soc. Biol. Paris, lxvii. (1909) pp. 169–71.
† Tom. cit., pp. 499–501 ‡ Tom. cit., pp. 174–6.
§ Comptes Rendus, cxlviii. (1909) pp. 1547–9.
‖ Arch. Zool. Expér., i. sér. 5 (1909) Notes et Revue, No. 3, pp. lxxxix.–xciii. (1 fig.). ¶ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 1061–2.
** Comptes Rendus, cxlix. (1909) pp. 94–7.
†† Op. cit., cxlviii. (1909) pp. 1142–6 (8 figs.).

New Hæmogregarine in Mites.*—W. W. Miller describes *Hepatozoon perniciosum* g. et sp. n., a Hæmogregarine pathogenic for white rats. It has its sexual cycle in a mite, *Selaps echidninus*, one of the Gamasidæ. The rats become infected by scratching their skin where the mites are, and then licking their paws. If the mites contain ripe sporocysts, the sporozoites become free in the rat's stomach, and penetrate to the blood vessels or lymph vessels of the liver. In the cells of the liver a schizogony occurs, and the merozoites pass into the circulation and are in great part taken up by leucocytes, in which they may encyst.

Lymphangitis of Horses.† — B. Galli-Valerio finds evidence that this disease is not fungoid but due to a Protozoon, described by Rivolta as *Cryptococcus farciminosus*. The affinities of the organism seem to warrant its reference to the genus *Leishmania*.

* Bull. U.S. Hygien. Lab., No. 46 (1908) 20 pls. See also Centralbl. Bakt. Parasitenk., xliv. (1909) pp. 596–7.
† Centralbl. Bakt. Parasitenk., xliv. (1909) pp. 577–82 (1 fig.).

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell Contents.

Chlorophyll Bodies.*—J. d'Arbaumont has made an extensive investigation of the chlorophyll bodies found in the stems and leaves of the Angiosperms and Gymnosperms. The writer classifies the chlorophyll bodies in two sections: in the first all the bodies are monotypic and confined to special cells, while those in the second section may be either in special cells or in any cells of the assimilatory tissues of the leaf and stem. These latter bodies, though inferior to those of the first section from a morphological point of view, are superior to them in respect to their function in the reduction of CO_2. In the final stages of their development, both series may or may not manufacture starch, and consequently the latter substance is not of such great importance in the building up of plant-tissues as is usually supposed.

Structure and Development.

Vegetative.

Seedling Anatomy.†—T. G. Hill and E. de Fraine have investigated the anatomy of seedlings of the Ginkgoaceæ and Cycadaceæ, and find that there are usually two cotyledons, which are imbedded in the prothallus throughout their existence. They are often unequal in size, and there is a tendency to form lobes at the apex and a cotyledonary tube at the base. In the Cycadaceæ the cotyledons may fuse ventrally. The number of bundles in each cotyledon varies, and is rendered more complicated by fusion and branching. Transition-phenomena take place rapidly, and vascular re-arrangements are made within the hypocotyl. In the Cycads examined the cotyledonary bundles fuse with the plumular traces, and ultimately form a central cylinder. The seed-leaf bundles play a very unequal part in the production of root-structure. After the first root-structure is laid down, the number of poles may increase at lower levels, and in *Ginkgo* protoxylem groups may be added subsequent to the attainment of root-structure.

Seedlings of Conifers.‡—T. G. Hill and E. de Fraine have investigated the seedling structure of *Tsuga*, *Abies*, *Picea*, *Cedrus*, *Pinus*, *Larix*, *Pseudolarix*, and *Araucaria*, in order to show that polycotyledony

* Ann. Sci. Nat. Bot., ix. (1909) pp. 197–229.
† Ann. Bot., xxiii. (1909) pp. 443–58 (1 pl.).
‡ Tom. cit., pp. 189–227 (1 pl.).

is the result of the splitting of a smaller number of cotyledons, probably two. The Taxineæ, Podocarpineæ, and many Cupressineæ, have two cotyledons, and the authors give evidence of partially split cotyledons, grouping of cotyledons, and cases of transition. In some cases, however, extra cotyledons may result from the displacement of foliage leaves from the first stem node to the cotyledonary node.

Leaf-structure of Strand Plants.*—J. W. Harshberger has studied the strand flora of New Jersey, which includes interesting representatives of sea-beach plants, dune plants, salt-marsh vegetation, and thickets. The author gives detailed descriptions of the structural adaptations in both salt-marsh plants and in the strand plants. The majority of the salt-marsh species showed two marked characteristics, viz. succulence and wiriness, and most of them had very smooth leaves. Further modification of leaf-structure was shown in such points as the presence of hairs, the depression of stomata, the increase in the number of rows of palisade cells, the presence of a hypodermis, thick cuticle, or thickened epidermis, etc. The true strand plants were still more modified, and in addition to the modifications exhibited by the salt-marsh plants, they often possessed overlapping leaves, or the surface of the leaf was papillate. In some cases the leaves had the power of changing their position with respect to the light. Other curious features observed include the presence of latex tissue, crystals, etc.

Anatomy of the Cortex of the Tubers of Balanophora.†— M. Strigl has studied the structure and function of the cortical tissue of the tubers of *Balanophora*, with the following results. There is no true epidermis, but several peripheral layers of lignified cells. Very young tubers have only one such layer, and this is increased by secondary thickening of adjacent parenchyma-cells, and there is no well-defined limit between the thickened cortex and the parenchyma-cells. There are peculiar and well-defined outgrowths of the cell-membrane, but it cannot be shown that these are due to the ingrowth of fungal hyphæ and their subsequently being surrounded by the membrane. The general structure of the cortex points to the absorption and conduction of water. The star-like irregularities of the tubers of *B. elongata* also appear to be arrangements for water absorption.

Root-modifications due to Artificial Wounding.‡—M. Ledoux has experimented upon the roots of *Lupinus albus*, *Soja hispida*, and *Pisum sativum*, and finds that when the main root is wounded there is abnormal intercalary growth in the wounded regions. There is also anatomical variation, the cortical tissues being much developed, the vascular bundles more numerous and differently orientated, and the central cylinder more or less modified : the formation of secondary tissues is retarded, and the wounded tissues are never replaced. It appears to be immaterial whether the wounding is near the apex or the base : the modifications are of the same kind in both cases.

* Proc. Amer. Phil. Soc. Philadelphia, xlviii. (1909) pp. 72–89 (4 pls.).
† SB. k. Akad. Wiss. Wien, cxvi. (1907) pp. 1041–60 (2 pls. and 3 figs.).
‡ Rev. Gén. Bot., xxi. (1909) pp. 225–40 (13 figs.).

Extra-floral Nectaries and Papillæ in Diospyros.*—E. Elsier has studied the extra-floral nectaries and papillæ of the under side of the leaf in *Diospyros discolor*, with the following results. The extra-floral nectaries which attract the protecting ants are only functional for a short time after the leaf-buds have opened. The nectaries attract the ants owing to a peculiar sort of "eye-formation." Each "eye-nectary" consists of a glandular body formed of many small cells, sunk in the mesophyll and separated from the latter by a layer of cork cells. These cork cells appear before the nectary begins secretion, and prevent the secretion from passing into the surrounding tissues instead of towards the outside; when the nectary has exhausted itself and drops off, the cork closes the wound. At first the nectary is formed from a single epidermal cell, but later on the subepidermal tissue shares in the formation of the nectary and the cork-layer. The papillæ are formed on the under side of the leaf by stiffened outgrowths from single epidermal cells. The cuticle is very loose in the neighbourhood of the papillæ, and forms folds between the latter. It is probable that this arrangement is a protection against the leaf being used by animals as food.

Extra-floral Nectaries of Melampyrum.†—H. Kirchmayr has studied the extra-floral nectaries of *Melampyrum*, and finds that they are present in *M. arvense*, *M. nemorosum*, *M. barbatum*, and *M. pratense*, but absent in *M. silvaticum*. They are not confined to the bracts, but are found on foliage leaves and cotyledons; in the latter case they function as hydathodes. The stalk-cell of the nectaries is of great importance in the regulation of pressure and in the exchange of material between the upper glandular layer and the basal cell-layer. All the glands originally have the same structure, but while the capitate glands retain their simple structure, the shield-glands develop into hydathodes, and still further modification results in the formation of nectaries. The latter serve to attract the ants, which bring about seed-distribution, and possibly serve to defend the plants against the attacks of snails.

Leaf-fall and its accompanying Phenomena.‡—E. Löwi has investigated leaf-fall in *Ampelopsis hederacea*, *Ligustrum vulgare*, *Aucuba japonica*, and other plants, and considers that there are six classes of mechanisms bringing about this phenomenon:—(1) circular cell mechanism, (2) decomposition, (3) maceration, (4) turgescence, (5) change in the cell-utricle, and (6) hard cell mechanism. Both the circular cell and maceration mechanisms depend upon the combined action of turgescence and decomposition of the cellular contents, but while in the former the turgescence is the chief factor, in the latter decomposition is most important. The formation of separation-layers, which are found in decomposition and changed utricle mechanisms, is due to modification of the thickening of the cell-wall. In the decomposition mechanism the cellulose breaks down until the cells are only surrounded by a thin membrane corresponding to the innermost layer of the original wall. In the cell-utricle mechanism the cell-membrane becomes thin through

* SB. k. Akad. Wiss. Wien, cxvi. (1907) pp. 1563–90 (2 pls.).
† Op. cit., cxvii. (1908) pp. 439–52 (1 pl. and 1 fig.).
‡ Op. cit. cxvi. (1907) pp. 983–1024 (1 pl. and 14 figs.).

growth of the cell; separation takes place through irregular growth, especially in the longitudinal direction. In the turgescence mechanism separation results from the disarrangement of thin-walled turgescent cells and shrivelled dead cells. Both the anatomical and physiological characters of the different separation mechanisms may vary in the same species under the influence of internal and external factors. The mechanisms are not sharply separated from one another, but pass by transition into one another.

Reproductive.

Megasporophyll of Saxegothæa and Microcachrys.*—R. B. Thomson has studied "some neglected phases of the inversion of the sporangial supply-bundles of both the staminate and ovulate cones" of *Saxegothæa* and *Microcachrys*. The author regards the fertile scale as a simple structure, and as homologous to the microsporophyll in both *Saxegothæa* and *Microcachrys*, and probably in the whole of the Taxaceæ. With this group is also associated the Araucarieæ; and thus in the two simple scale-groups the microsporangia and the megasporangia are on opposite sides of the sporophyll, and as their ancestral homosporous forms usually have the sporangia on the lower surface, "the ovule has probably been transferred to the upper surface in the course of phylogeny."

Closing of the Micropyle of Gymnosperms.†—W. Himmelbaur has studied the phenomenon of the closing of the micropyle in Gymnosperms, especially in *Larix*. The author finds that the epidermal and subepidermal cells of the free ends of the integument become greatly disorganised and cutinised. The outer wall of the integument becomes much elongated, and bends inwards towards the micropyle, so that the inner cutinised mass, with the pollen-grains adhering to it, is borne into the interior of the seed. It would appear that the sticky material developed in connection with the cutin serves to hold fast the pollen-grains, and that the bending-in of the integument serves as a sort of pollen-tube for bringing the pollen-grains into contact with the nucellus, and also protects the former between pollination and fertilisation. The whole arrangement is a relic of the independence of the sexual generation.

Structure of the Antennæ in Catasetum.‡—H. von Guttenberg has made a study of the antennæ of eight species of *Catasetum*, and finds that in *C. barbatum*, *C. cernuum*, *C. fimbriatum*, *C. ornithorhynchos*, and *C. Trulla*, there are no sensitive papillæ, but they are present in *C. callosum*, *C. tridentatum*, and *C. splendens*. In those species which have no papillæ the antennæ themselves act as sensitive threads, which transfer every movement to a basal joint; and in connection with this function various modifications of the antennæ are to be observed, the most usual being a thickening or lignification of the turned-in edges, which may extend to the very tip of the antennæ, and at the same time a weakening of the cells at the joint. In *C. ornithorhynchos* there are sensitive

* Bot. Gaz., xlvii. (1909) pp. 345–54 (4 pls.).
† SB. k. Akad. Wiss. Wien, cxvii. (1908) pp. 3–24 (2 pls. and 2 figs.).
‡ Tom. cit., pp. 347–68 (2 pls.).

outgrowths, and other types exhibit more or less perfect adaptations. The highest developed types are those with the special papillæ, *C. callosum* being the most perfect.

Parthenogenesis in Pinus Pinaster.*—W. T. Saxton contributes a short paper dealing with evidence which tends to prove the occurrence of parthenogenesis in this species of *Pinus*. The chief points are as follows. The oosphere nucleus divides before being reached by the pollen-tube or sperm-nuclei. The segregation of the chromosomes into two groups in the first and second divisions of the normal oospore-nucleus cannot be seen. The disorganisation of the apex of the archegonium and the displacement of the receptive vacuole which occurs in fertilisation does not take place. The remains of the second sperm-nucleus, tube-nucleus, and stalk-cell, can be distinguished in the upper part of the archegonium in fertilisation, but cannot be seen here. Both parthenogenetic and normal embryos develop, but it is as yet impossible to say whether seeds containing parthenogenetic embryos are capable of germination.

Embryo-sac of Passiflora adenophylla.†—M. T. Cook has studied the embryo-sac of *Passiflora adenophylla*, and contributes a note upon certain peculiarities which it exhibits. The pollen-tube is very prominent, and double fertilisation is a frequent and conspicuous phenomenon. The most curious feature, however, is the behaviour of the pollen-tube, which often develops abnormally at the expense of the embryo-sac, which it ultimately fills. When this is the case it does not discharge its contents, and no embryo-formation takes place.

Chemical Solutions and Bud Development.‡—J. W. Harshberger has studied the sequence of bud development, with the object of determining whether it is due to heredity, to the character or disposition of the reserve food, or solely to climatic conditions. The experiments have extended over two years, and the species studied were *Quercus palustris*, *Æsculus Hippocastanum*, and several others equally well known. Twigs were grown in various chemical solutions, and although they responded to the stimulus of the chemicals, the sequence of bud-opening was not disturbed. Microscopic studies of the plant-tissues show that the character and position of the food-material render the protoplasm more or less responsive to external conditions. If the amount of food-reserve is great and easily accessible, the response is rapid, and *vice versa*, but this relationship must not be pushed too far. Heat appears to be the great factor which determines the opening of buds.

Physiology.

Nutrition and Growth.

Utilisation of Atmospheric Nitrogen by Specialised Hairs.§—F. Kövessi contributes a note upon the opinions recently published by

* Bot. Gaz., xlvii. (1909) pp. 406–9 (7 figs.).
† Bull. Torrey Bot. Club, xxxvi. (1909) pp. 273–4 (1 pl.).
‡ Proc. Acad. Nat. Sci. Philadelphia, lxi. (1909) pp. 57–110.
§ Comptes Rendus, cxlix. (1909) pp. 56–8.

certain authors respecting the absorption of atmospheric nitrogen by certain specialised hairs. After repeating the experiments upon which these opinions were based, the author concludes that there is no evidence to show that albuminoids present in the hair derive their nitrogen from the air.

Irritability.

Organs of Light-perception in Foliage-leaves.*—F. Seefried has investigated sixty species of shade-plants with reference to the organs of light-perception in the leaves. In all of them the writer has found light-perception organs on the upper surface of the leaves. In eight species the epidermal cells had level outer walls and arched inner walls; in two the outer walls were arched and the inner walls level, while in thirty-three both the outer and inner walls were arched. In special relation, also, to these modifications of the epidermis-cells, are to be noticed such points as conical papillæ over the outer walls. In many cases the cells in the neighbourhood of vascular bundles, or near the edge of the leaf, show a greater optical activity than the remaining epidermal cells. Sometimes the light-concentrating cells are so powerful that they remain active even when the leaf is slightly wet. Special means of light-concentration are also provided by lens-like papillæ, lens-like thickening of the middle of the outer epidermal wall, etc. In some instances the modification of hairs results in the formation of ocelli. Not unfrequently the leaf cuticle has a granular covering, which prevents the injurious effects of wet on the light-perception organs.

Light-perception in Foliage-leaves.†—G. Haberlandt contributes a further paper dealing with light-perception. The author has observed twenty-eight species, including species of *Fagus*, *Betula*, *Ulmus*, *Quercus*, *Malva*, *Ranunculus*, *Convolvulus*, etc., and finds that his theory of light-perception is still further confirmed. All the species examined possessed organs for light-perception similar to those previously described. In twenty-two the outer walls of the epidermal cells are more or less arched, and the cells function as concentrating lenses. In the remaining six species the outer walls are level, but the inner walls are plainly arched, and the cells function in a similar manner to those of the preceding species. The author considers that those who oppose his theory have up to the present failed to disprove it.

General.

Floral Coloration in Relation to Bees.‡—J. H. Lovell has made observations upon *Pyrus communis*, *Borago officinalis*, and *Cucurbita maxima*, in order to test whether conspicuousness of colour is an advantage to flowers. While these and other experiments, made with honey placed upon coloured glass, seem to show that some allowance must be made for the intelligence of the bees and other highly-developed insects in discovering nectar, the evidence is conclusively in favour of

* SB. k. Akad. Wiss. Wien, cxvi. (1907) pp. 1311–57 (4 pls.).
† Op. cit., cxvii. (1908) pp. 621–35 (1 pl.).
‡ Amer. Nat., xliii. (1909) pp. 338–49.

those writers who regard colour as of the greatest importance in the attraction of insects. The scent of many flowers is also an important factor, but the present writer disagrees with those authors who make it of primary importance.

Cleistogamy in Linaria.*—E. J. Hill has studied *Linaria canadensis*, with special reference to pollination. The author finds that plants of 10–15 cm. in height are usually cleistogamic, those of 12–15 cm. in height are partially cleistogamic, but have a few small, open flowers, while plants 15–20 cm. high have larger flowers, and only a few cleistogamic. The cleistogamic condition is also affected by change in season; during the spring and early summer the flowers may be visited by insects, and cross-fertilisation is brought about; but by June the flowers begin to decrease in size, until ultimately they are all cleistogamic. In dry regions even tall plants bear cleistogamic flowers. The behaviour of *Linaria* in this respect appears to be connected with the increase of light and heat and the decrease of moisture. Cleistogamic flowers require less food, and so husband the resources of the plant for seed-production; also, in cleistogamic flowers the essential organs are better protected. *Linaria canadensis* is an example of a plant degenerating from a highly-evolved form of insect-pollination to the self-pollination of a cleistogamic condition.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A. F.L.S.)

Vascular Structure of Gleichenia.†—L. A. Boodle and W. E. Hiley describe the vascular structure of some species of *Gleichenia*, especially *G. pectinata*, which differs from all other members of the genus in having a solenostelic rhizome. The structure of the node is similar to that of *G. flabellata*, with certain complications due to leaf-gaps and solenostely. The rhizome of *G. pectinata* branches in two ways, monopodially in the vertical plane, and dichotomously in the horizontal plane. *Eugleichenia* represents a series of forms showing reduction from the typical *Martensia* type, as represented by *G. flabellata*. *Martensia* includes the most primitive species of *Gleichenia* as well as the most advanced, viz. *G. pectinata*. The solenostelic structure of *G. pectinata* is to be regarded as derived from a protostelic *Martensia* type like that of *G. flabellata*. The course of evolution may have consisted in the formation of a pith and ramular gaps, followed by intrusion of phloem, etc., through a ramular gap into the pith and subsequent extension throughout the rhizome.

Mesarch Structure in Lycopodium.‡—E. W. Sinnott gives a sketch of what has been written about the position of the protoxylem in relation to the later-formed elements of the wood in fossil and living plants, and

* Bot. Gaz., xlvii. (1909) pp. 454–66 (4 figs.).
† Ann. of Bot., xxiii. (1909) pp. 419–32.
‡ Bot. Gaz., xlviii. (1909) pp. 138–44 (1 pl.).

describes his own investigations to determine the presence or absence of mesarch development in *Lycopodium*. The general conclusions to which he has come are that the position of the protoxylem in the primary wood-bundle of vascular cryptogams is very variable, and may be almost anywhere in the strand. It is therefore of little value in determining the relationship of one group to another. A constant primitive feature, however, of vascular cryptogams is the presence in the stem of cryptogamic wood—centripetal xylem continuous with the protoxylem elements. Whenever such a feature occurs in any of the higher plants it is evidence of affinity with the vascular cryptogams in general, and not with any particular group of them.

Spore-wall of Equisetum.*—R. Beer gives an account of the development of the spores of *Equisetum*. The wall of the mature spore consists of four layers, viz. the outside layer (the elater), the "middle layer," the exospore, and the endospore (innermost and last-formed). As to the origin and interpretation of these four layers, there is a surprising diversity of opinion. The author summarises the views that have been expressed :—1. All four layers are formed by the spore-protoplast in centripetal succession. 2. The outermost and the middle layer are derived from the special-mother-cell wall, the exospore and endospore from the spore-protoplast. 3. The outermost layer is derived from the special-mother-cell wall ; the middle layer, the exospore, and the endospore are formed by the spore-protoplast. 4. The outermost layer is formed by the tapetal cytoplasm ; the middle layer, the exospore, and the endospore are formed by the spore-protoplast. The author has carefully studied the spore-development in *E. arvense* and *E. limosum*, and describes the nuclear changes and the formation of the spore-wall. The first wall formed becomes subsequently the exospore, and with the endospore is the product of the spore-protoplast ; while the middle layer and the elater-layer are successively formed by the tapetal cytoplasm.

Fossil Cone of Calamostachys Binneyana.†—H. H. Thomas describes a cone of *Calamostachys Binneyana* (Carr.) attached to a leafy shoot. It was found in the Lower Coal Measures at Huddersfield. The leaves are small, linear, and arranged in whorls, but not fused at base. They are almost identical in structure with the bracts. Between the whorls of leaves a large number of small, black, hair-like structures occur on the stem. At the base of the cone is a ring of tissue much like the annulus of a modern *Equisetum* cone. The cone described is probably identical with the impressions known as *Paracalamostachys Williamsoni* Weiss and with *Calamostachys grandis* Zeiller, which has similar leaves ; but it is possible that the name *Calamostachys Binneyana* represents a type rather than a species. The bracts of the cone cannot be regarded as sterilised sporophyll lobes.

Mesostrobus, a new Fossil Cone.‡—D. M. S. Watson describes *Mesostrobus*, a new genus of Lycopodiaceous cones from the Lower Coal

* New Phytologist, viii. (1909) pp. 261-6.
† Tom. cit., pp. 249-60 (1 pl. and figs.).
‡ Ann. of Bot., xxiii. (1909) pp. 379-97 (1 pl.).

Measures, and adds a note on the systematic position of *Spencerites*. The cone of *Mesostrobus Scottii* differs from that of *Lepidostrobus* in having the sporangium attached to the distal half of the horizontal portion of the sporophyll, and the ligule is relatively larger and set in a deep pit.

Genus Ceratopteris.*—R. C. Benedict publishes a preliminary revision of the genus *Ceratopteris*, a complicated group of hydrophytic leptosporangiate ferns, which vary considerably not only in leaf-form and habit, but also in the more fundamental characters of the sporangium, but have till recently been regarded as but a single species. The author has discovered that the number of spores per sporangium varies with the different species, and that this variation and the variation in the development of the annulus can be correlated with the variation in leaf-form. The following four species are defined: *C. thalictroides* Brongn., *C. Lockharti* Kunze, *C. pteridioides* Hieron., and *C. deltoidea*, a new species.

Stigmatopteris, a new Genus of Ferns.†—C. Christensen gives an account of *Stigmatopteris*, a new genus of ferns, in which he brings together twelve South American species closely related by certain characters which have not hitherto been considered as of generic value. They are all exindusiate, and belong to the old genus *Phegopteris*, and are most nearly related, not to *Dryopteris*, but to *Phanerophlebia*. The common characters of all the species of *Stigmatopteris* are as follows. The lamina is pellucid-punctate, with immersed yellow glands, and destitute of hairs; the stipes, rachis, and costæ are squamose; the veinlets are free or more or less anastomosing, and do not reach the margin, but end in a clavate apex ("hydathode"); the long acuminate apex of the pinnæ is sharply serrate to its very tip; and, finally, though tropical ferns are rarely infected by parasitic fungi, yet most specimens of *Stigmatopteris* are injured by a black incrusting fungus (*Parmularia stigmatopteridis*). The author gives an annotated enumeration of the species, with figures, and a key. The species are separable with difficulty, but fall into two groups.

Galls on Ferns.‡—K. Giesenhagen describes and figures two instances of galls on ferns—on *Hymenophyllum lineare* var. *brasiliense* and on *H. Ulei*—pointing out the parts affected and the nature of the deformation. They are both caused by the larvæ of different species of Diptera. Galls on ferns are of very rare occurrence.

Bryophyta.

(By A. Gepp.)

Fertilisation in Marchantia.§—K. Gehrmann writes on the physiology of fertilisation in *Marchantia polymorpha*, calling attention in particular to the epidermal papillæ on the upper surface of the female

* Bull. Torrey Bot. Club, xxxvi. (1909) pp. 463–76 (3 figs.).
† Bot. Tidsskrift, xxix. (1909) pp. 291–304 (figs.).
‡ Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 327–34 (pl.).
§ Tom. cit., pp. 341–8 (figs.).

receptaculum, which by their capillary attraction constitute an apparatus for quickly diffusing the water in which the male reproductive cells are transported.

Tortula aciphylla in Britain.*—W. E. Nicholson records the first finding of *Tortula aciphylla* in Britain, namely, on Ben Lawers, last June. It is a moss of the European mountains, and is found in North America. Nicholson shows how it is distinguished from *T. ruralis* in shape of capsule and colour of oophyte, but especially in the excurrent hair-point of the leaves, which is reddish and nearly smooth as compared with the spinose hyaline hair-point of *T. ruralis*. *T. aciphylla* is an alpine, *T. ruralis* a lowland species.

Ricciocarpus natans.†—W. West publishes a note on *Ricciocarpus natans*. It was growing among *Scirpus lacustris*, in a pond near Doncaster, last June, and was associated with *Lemna trisulca*. In thin open parts the latter predominated to the exclusion of the other, whereas in well-shaded places the *Ricciocarpus* grew almost pure.

Belgian Bryophytes.—A. Cornet‡ announces the discovery of *Bryum fallax* Milde in Belgium. He found it growing plentifully on mortar, sterile and associated with *Trichostomum crispulum*. He points out its resemblance to, and difference from, *B. pallens*, and sketches its distribution.

He also records § *Webera Rothii* Correns and *Lophozia badensis* Schiffn. as additions to the Belgian flora. *Webera Rothii* is one of the four species into which *W. annotina* has been split, and is as yet not much known, but has been recorded for North Germany and Tyrol. *Lophozia badensis* is a species intermediate between *L. turbinata* and *L. Muelleri*, and as it has been united with the former species by several authors its proper distribution is not clear.

H. van den Broek ‖ publishes a list of the Sphagnaceæ of the neighbourhood of Antwerp. He has collected during twenty-five years, during which time the number of European species of *Sphagnum* has been doubled. In preparing his list he has followed the system elaborated by Warnstorf, and enumerates thirty-one species and numerous varieties and forms.

Mosses of Carinthia.¶—F. Kern gives an account of the moss-flora of the Carinthian Alps, prefaced by a brief geological sketch of the district, and some indication of the effect of the calcareous and slate rocks respectively upon the flora. He enumerates 210 species of moss and 56 hepatics, citing their localities and altitudes.

European Hepatics.**—K. Mueller, in the ninth part of his Die Lebermoose, gives descriptions and figures of the remaining three species

* Journ. Bot., xlvii. (1909) pp. 374–5 (pl.).
† Naturalist, No. 632 (1909) p. 321.
‡ Bull. Soc. Roy. Bot. Belg., liv. (1908) pp. 334–5.
§ Tom. cit., pp. 341–3.
‖ Tom. cit., pp. 365–73.
¶ 86th Jahres-Bericht Schlesisch Ges. Breslau, Abt. ii. 1909, pp. 3 17.
** Rabenhorst's Krypt. Flora, vi. lief. 9 (1909) pp. 513–76 (figs. 267–86).

of *Alicularia*, of the genus *Eucalyx* and its three species, of *Haplozia* and its ten species, and of *Jamesoniella* with one species. As in the earlier parts, so here, also, he supplies keys, critical notes, affinity tables, etc.

Mosses of the Atlantic Islands.*—H. N. Dixon publishes notes on two collections of mosses gathered in the Atlantic Islands, the one in Madeira by E. Armitage, the other in the Azores by G. C. Druce. 1. The Madeira collection comprised some 180 specimens in 76 species, and included 18 additions to the moss-flora of the island and three to the flora of the Atlantic Islands. One of the latter three is *Dicranella heteromalla*, male plants with the interesting character of axillary bulbils. To *Grimmia trichophylla* should be referred as varieties or subspecies the following: *G. Lisæ*, *G. canariensis*, *G. subsquarrosa*, *G. Stirtoni*, and *G. azorica*. *Brachymenium Philnotula* appears indistinguishable from the East African type. 2. The Azores collection, though small (13 specimens), included a new species, *Bryum clavatulum*.

Synonymy of European and North American Mosses.†—N. C. Kindberg publishes notes on the synonymy of European and North American Bryineæ, being a list obtained by collating the nomenclature employed in his own European and North American Bryineæ with that in V. F. Brotherus' Bryales in Engler and Prantl's Die natürlichen Pflanzenfamilien.

North American Mosses.‡—C. C. Plitt gives an account of the methods of asexual reproduction observed by various authors in *Leucobryum glaucum*, viz. the formation of rhizoids on ordinary or on perichætial leaves, or the formation of leaves readily breakable from the parent stem.

I. Hagen exposes§ a blunder in nomenclature by which the binomial *Eleutera ornithopodioides* was set up by S. C. Stuntz in place of *Neckera complanata* in 1900.

E. G. Britton ‖ publishes some notes on C. G. Pringle's Mexican mosses.

Mosses of Mexico.¶—J. Cardot continues to publish his preliminary diagnoses of Mexican mosses. The third instalment contains thirty-three new species and varieties, mostly belonging to the orders Grimmiaceæ and Bryaceæ.

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

Marine Algæ of the West of Ireland.**—A. D. Cotton gives a brief sketch of the survey which is being made of Clare Island and its immediate neighbourhood on the mainland. From the point of view of

* Journ. Bot., xlvii. (1909) pp. 365-74 (pl.).
† Rev. Bryolog., xxxvi. (1909) pp. 115–17.
‡ Bryologist, xii. (1909) pp. 79-81 (figs.).
§ Tom. cit., p. 82. ‖ Tom. cit., p. 83.
¶ Rev. Bryolog., xxxvi. (1909) pp. 105–15.
** Kew Bulletin, 1909, pp. 312–15.

marine algæ, much valuable work may be done there, and the author describes the various types of collecting ground in the area. Almost all types are represented, and there is plenty of work to be done both in shore-collecting and dredging. The author finds that in Clare Island the conditions dependent upon temperature and salinity of water and the physical nature of the coast are fairly uniform, and the distribution of the algæ and algal associations appear to be principally affected by conditions of illumination, desiccation, and exposure to waves and rough water. Mr. Cotton's notes will be of great service to all collectors of marine algæ in the area to be surveyed.

Algæ New to Japan.*—K. Yendo records twenty-nine species and varieties new to Japan, together with notes on the habitat, synonymy, and structure. The note on *Halosaccion saccatum* is especially interesting; the author considers that *Dumontia fucicola* P. & R. and *D. decapitata* P. & R. are nothing but young forms of *Halosaccion saccatum* Kütz., and the same may be said of *H. hydrophora*, with its three varieties. The latter are merely modifications due to age or habit.

Japanese Algæ.† — K. Okamura publishes a further part of his valuable Icones of Japanese Algæ, containing figures of *Ceratodictyon spongiosum* Zan., *Martensia elegans* Her., *Gelidium pusillum* Le Jol., and a new species, *Herpopteros zonaricola* Okam. The last of these grows on the frond of *Zonaria Diesingiana*. It is described in detail.

Algæ of Egypt.‡—R. Muschler enumerates the algæ, both marine and fresh-water, hitherto observed in Egypt. He founds the list on his own rich collections and on the large quantity of material in the Berlin Botanical Museum. The number of species and varieties in the list is 261, some of which are new records and some from new localities.

Phytoplankton of Victoria Nyanza.§—C. H. Ostenfeld publishes further notes on this subject, founded on samples collected in February 1908 at Mwanza and Shirati, on the southern shore of the lake. The author finds that a comparison of this collection with the others which he has examined show that the diatoms (especially *Melosira*) are dominant in the early spring, while later in the year the green algæ and blue-green algæ reach their maximum. In this way the Victoria Nyanza resembles the lakes in the lowlands of temperate Europe. It and Lake Nyassa differ, however, from European lakes in the absence, either partial or complete, of *Asterionella*, *Fragilaria crotonensis*, and *Ceratium hirundinella*; while, on the other hand, the African lakes contain a number of beautiful forms of *Surirella* and numerous desmids. This last feature they have in common with the lakes of West Europe (Great Britain), but the species are different. The consecutive order of the plankton maxima in Victoria Nyanza is:—February: *Melosira Agassizii* dominates; other diatoms of less importance; green and blue-green algæ

* Tokyo Bot. Mag., xxiii. (1909) pp. 117–33.
† Icon. Japanese Algæ, ii. No. 1 (1909) pp. 1–20 (5 pls. and descriptive text).
‡ Mém. présent. à l'Instit. égypt., v. fasc. iii. (1908) pp. 141–237. See also Bot. Zeit., lxvii. (1909) pp. 212–13.
§ Bull. Mus. Comp. Zool., Harvard Coll., lii. (1909) pp. 171–81 (2 pls.).

rather scarce. April: green algæ, both desmids and Protococcoideæ dominate; diatoms of less importance; blue-green algæ rather scarce. October and November: Myxophyceæ dominant, but both green algæ (especially *Botryococcus Braunii*) and diatoms (*Melosira nyassensis* and Surirellæ) subdominant. Plankton very rich in species and individuals. The author makes critical remarks on certain species of Peridiniales, Bacillariales, and Myxophyceæ and Chlorophyceæ. *M. Agassizii* is described and figured as a new species.

Green Algæ of North America.*—F. S. Collins publishes an account of the green algæ of North America, from the Arctic Ocean to the Isthmus of Panama, including the West Indian Islands. In the green algæ are included not only the Chlorophyceæ, but also the small class of the Heterokontæ, but the Desmidiaceæ and Characeæ are omitted. Under each species is a concise description, with a record of the localities in which it has been found. Reference is also given to the original publication of the binomial, and to some good figure or plate, and where a specimen of the species in question has been published in some exsiccatæ, reference is also made to that. In the plates there is at least one figure for each genus, and in most cases these are taken from standard works. A key is given to the species of each genus. In an introduction the author describes methods of collecting and mounting the various kinds of algæ, different types requiring different treatment.

North-American Fresh-water Algæ.†—O. Borge publishes a list of fresh-water algæ from North America preserved in the Museum at Stockholm. The new species described are *Closterium pseudolunula* and *Anabæna californica*.

Action of Mineral Waters on Diatoms.‡—A. Lauby has investigated the causes of the presence of brackish-water species of diatoms in some of the strata of Mount Dore and the neighbourhood. The deposits are of Tertiary origin, and the author, for reasons here set forth, believes that the brackish-water and marine species argue the presence in the old Tertiary lakes of mineral springs, somewhat similar to that of Saint-Nectaire at the present day. Species of diatoms, showing the same variation, were found in the mineral waters of Saint-Nectare and in the old deposits of Courançon. The development of certain peculiarities is explained.

Green Coloration of Oysters.§—L. Calvert and P. Paul give an account of their experiments with the "Diatomée bleue" (*Navicula ostrearia* Bory) in connection with oyster culture in the south of France. The green oysters of Marennes are much esteemed by gourmets, consequently attempts were made to induce the oysters in the great tanks or basins at Balaruc-les-Bains (Hérault) to assume the green coloration naturally, the coloration being due to the presence of the aforesaid diatom. Genuine green oysters of Marennes were introduced into the

* Tuft's College Studies, ii. No. 3 (1909) pp. 77–480 (18 pls.).
† Arkiv f. Botanik. viii. (1909) No. 13, pp. 1–29 (1 pl.).
‡ Comptes Rendus, cxlix. (1909) pp. 529–32.
§ C.R. Soc. Biol. Paris, lxvi. (1909) pp. 1036–8.

basins in November 1908 and February 1909; but no greening of the oysters had taken place up to the beginning of April, when the basins were partially emptied and most of the oysters removed, and the water supply was cut off. But ten days later the basin began to have a blue tinge, and the oysters became an intense green, the diatoms having undergone rapid multiplication. To make cause and effect clear, further experiments are required; but it is already evident that the following conditions favour the development of the diatoms: (1) stagnation of the water in the basins; (2) low level of the water; (3) temperature of water varying between 13° and 21° C.; (4) a salinity of about the density 1016 to 1017; (5) neglect generally.

Marine Diatom which stores up Manganese.*—J. Peklo describes a species of *Cocconeis* growing on a quantity of *Cladophora fracta* var. *marina*; it was coated by a deposit of manganese, and formed a brownish-black mass on the shore of one of the Dalmatian Islands. He describes the various methods he employed for analysis, and the corresponding results. The deposit seems to be derived from manganese carbonate taken up by the plant.

Fossil Diatoms at Furnas.†—F. A. Chaves writes an interesting account of two strata of fossil diatoms in the island of St. Michael, one of the Azores. They were both discovered by himself some years ago, and, having been prevented from completing his researches on them, he now publishes his notes. After discussing various geological strata in the Azores, the author gives lists of the fossil diatoms found in the Bargado and the Tambôres beds. The first contains 38 species, the second 56. Of these 27 are common to both. A list of the living diatoms known from the Azores follows, numbering 126, and a comparison of these with the fossils of Bargado and Tambôres shows that 27 and 37 species respectively are common to the fossil and living species. Then follows a list of 91 species from the fossil deposits of Auvergne, and comparison between these and the Azores beds shows that 23 and 30 species only are common respectively to the two regions. It is, therefore, impossible to establish any analogy between the two regions other than their formation in fresh-water. The author then gives his views on the mode of formation of the strata at Bargado, with a photograph of the spot where the fossil diatoms are found.

Morphology of the Base of Cladophora.‡—F. Brand has made a study of this subject, and describes and figures the base of *Cladophora glomerata*. By the term "base" he understands the lowest part of the main filament, together with the basal organ of attachment. Up to the present time stress has always been laid on the absence of primary rhizoids in the hydrophilous Ægagropilæ and *C. fracta*, but the varying form of the base of stationary species has never been described. The author finds that the basal shoot of the germinating plantlet divides at a very early stage into two branches, or, in certain cases, into more

* Bot. Zeitsch., lix. (1909) pp. 289–98 (1 pl.).
† Bull. Soc. Portugaise Sci. Nat., ii. (1909) pp. 231–55.
‡ Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 292–300 (figs. in text).

than two. Where there are two, the one grows out as the axis, while the other may be regarded as a branch. Further development is very varied, but one character seems to be fairly constant. On one or other of the rhizoid-branches there arises a short and thick cell, from which grows a bushy short-celled group of branches, the cells of which are short and of irregular form. Sometimes there are so many of these groups that the basal system of rhizoids resembles the root-stock of *Neottia*; and in other cases it appears as if the plant were arising from a mass of cells. In later stages these bushy branches break up into separate cells. It is possible that they serve for the multiplication of the plant. Certainly this function belongs to the primary rhizoid, which in middle and old age develops stolons, and may bear numerous young plants. Adventive rhizoids arise from older vegetative filaments—Wille calls these "strengthening-rhizines" ("Verstärkungs-rhizinen"), and divides them into extracuticular and intracuticular. These are here discussed. Finally, the author remarks on the extraordinary power of reproduction and multiplication possessed by *Cladophora glomerata*, which may take place in six different ways; and he describes the best methods for preparing and staining material for examination.

Growth of Fucus.*—P. Hariot makes a communication on the growth of species of *Fucus*. These algæ, together with species of Melobesiæ, are largely used for manure on the western coasts of France, but they may only be collected at certain seasons, according to law. The author has therefore made some experiments as to their rate of growth, both for scientific and economic interest. At Tatihou, in November 1908, he scraped clean two rocks covered with *F. vesiculosus* and *F. platycarpus*. One of these rocks was easy to observe at low tide, being in the outer port, while the other was further out. One of the harbour walls was also scraped. The denuded rocks became covered at first with a layer of green algæ, *Ulva* and *Enteromorpha*; and only when these had come to an end, about six months after the scraping, did young plants of *Fucus* begin to appear. On July 9 the young shoots on the nearer rock were 5–6 mm. high, while those of the other rock were 3–4 mm. high, and on the harbour wall there were no algæ of any sort. The tufts of *Fucus* cut off close to the rock did not begin to shoot again till January. Further observations will be made and the results published. In the meantime, the author draws the conclusion that the growth of *Fucus* is slow.

Laminariæ of the Mediterranean.†—G. Zodda publishes some notes on the species of *Laminaria* which occur in the Mediterranean, which only amount to four, namely, *L. Rodriguezii* Born., which is endemic, a doubtful record of *L. digitata*, *L. saccharina*, and *L. bulbosa*. On the latter species the author makes a few remarks, discussing the form *mediterranea*, which is considered by authors to be merely a juvenile form of *Saccorhiza bulbosa*, or, as the author prefers to call the species, *Laminaria bulbosa*. He points out that the sporangia occur both on

* Comptes Rendus, cxlix. (1909) pp. 352–4.
† Nuov. Notar., xx. (1909) pp. 94–9.

the bulb and on the lamina, and that therefore the only reason for separating the species from *Laminaria* is done away with. It differs from *Laminaria* only in the possession of a bulbous base, while from the other species of *Saccorhiza*, *S. dermatodea*, it differs in the important character of possessing cryptostomata, which are absent in *S. dermatodea*. *S. bulbosa* should, therefore, be replaced in *Laminaria*, possibly in a subgenus.

Ceramium pallens.*—G. B. De Toni has made an examination of the type specimen of *Ceramium pallens* Zanardini, and decides that it is no more than a form of the variable *C. barbatum* Kütz. The sporangia are divided cruciately and not triangularly; and in immature sporangia there is simply a bipartition resembling the spores of *Crouania bispora*. The presence of cruciately divided sporangia in a plant which otherwise exactly resembles *Ceramium barbatum*, is not sufficient, in the author's opinion, to justify its position as a distinct species; and the more so, since there is so great a variability in this respect in other genera, and sometimes even in the same species, of the Ceramiaceæ. He discusses this question, and gives examples to prove his point.

LUCAS, A. H. S.—**Revised List of the Fucoideæ and Florideæ of Australia.**
[The author devotes his Presidential Address to this subject, and enumerates 1050 species of marine algæ from Australia.]
Proc. Linn. Soc. New South Wales, xxxiv. (1909) pp. 8–60.

MAZZA, A.—**Saggio di Algologia oceanica.** (Notes on marine algæ.)
[A continuation, in which are treated *Chondria*, *Cladhymenia*, *Lophurella*, and part of *Polysiphonia*.] *Nuov. Notar.*, xx. (1909) pp. 65–86.

RASMUSSEN, R.—**Bemaerkninger om Vaeksten af Bladet hos Alaria esculenta paa Faeröerne.** (Remarks on the growth of the frond in *Alaria esculenta* at the Faeroes.)
[Describes and figures the periodical renewal of the lamina.]
Bot. Tidsskrift,, xxix. (1909) pp. 333–5 (figs.)

SCHODDUYN, R.—**Un coup d'œil sur la Flore algologique des eaux-douces et saumâtres de Bergues (Nord).** (A glance at the algological flora of fresh and brackish water at Bergues).
[A list of 153 species.]
Bull. Acad. Internat. Géogr. Bot., xvii. (1909) pp. 163–72.

Fungi.

(By A. LORRAIN SMITH, F.L.S.)

Contribution to the Cytology of Synchytrium and its Hosts.†—S. Kusano has followed the development of *Synchytrium Puerariæ* and *S. decipiens*, both of which are practically the same. Swarm-spores of the fungus are liberated on the surface of the leaf, and enter by the stomata or water-pores; in the tissue the spore grows out to a spherical orange-yellow body. Successive mitotic nuclear divisions take place; five chromosomes are formed; an intranuclear spindle appears, and the nuclear membrane disappears; after migration of the chromosomes the spindle breaks at the centre, and a half is withdrawn to each pole;

* Nuov. Notar., xx. (1909) pp. 87–93.
† Bull. Coll. Agric. Tokyo Imp. Univ., viii. 2 (1909) pp. 79–147 (4 pls.). See also Bot. Centralbl., cxi. (1909) pp. 226–7.

a dense cytoplasmic mass appears at the end, changes into a prominent aster, and aids in the formation of the nuclear membrane; this centrosphere-like body Kusano proposes to call the "karyodermatoplast." After repeated nuclear divisions, the cytoplasm divides into polyhedral masses, which become multinucleate sporangia, each one giving rise to 200 to 300 swarm-spores.

Nuclear Phenomena in Pyronema confluens.*—W. H. Brown gives a preliminary note of his investigation of a form of *Pyronema*, which agrees outwardly with *P. confluens*, as investigated by Harper, but differs in the behaviour of the nuclear fusions. Brown suggests that he may be dealing with a variety or form of Harper's fungus. Trichogynes and antheridia were formed in it, but they were never in contact, and the nuclei of the antheridia degenerated. No fusion of nuclei occurred either in the ascogonium or ascogenous hyphæ, except in the binucleate cell which forms the ascus. He also finds that there is only one reduction in the ascus—it occurs in the first division of the primary ascus nucleus, when there is what appears to be a synapsis and a split spireme, followed by the passing of four or five chromosomes to each pole.

Sexuality and Development of the Ascocarp in Ascophanus carneus.†—E. M. Cutting gives an account of the systematic position of this fungus, then describes his methods of securing the plant, and of preparing the microscopic sections. He also describes his experiments in the germination of the spores; he was unable to induce growth further than the production of germ-tubes. The cells of the vegetative mycelium are multinucleate; the nuclei are minute, and seem to divide karyokinetically. There is a pore in the middle of the transverse wall of each cell, and on either side of the pore a number of granules are situated. A pore is also present in the ascogonial cells. One ascogonium gives rise to the fruit. The archicarp is a "solecite" composed of a varying number of cells, either simply curved, or twisted in a complicated manner. There is no male organ; the apical portion of the archicarp may possibly represent the trichogyne. The middle portion functions as an ascogonium, and the cells composing it seem to be multinucleate at their formation; fusion between nuclei seems to take place in all the cells; there is no nuclear migration from one cell to another. All the ascogonial cells have the power of giving off ascogenous hyphæ; the tips bend over in the usual manner, and the ascus is formed from the penultimate cell. Cutting regards the fusion of nuclei in the ascogonial cells as a reduced type of fertilization in which the female nuclei fuse in pairs. He is of opinion that the genus *Ascophanus* presents many points of similarity with *Ascobolus* and *Lasiobolus*, and ought to be retained in the Ascobolaceæ. A full bibliography completes the paper.

Nuclear Division in the Ascus.‡—A. Guilliermond challenges the results obtained by Fraser and Welsford in their work on the cytology of the ascus. He denies the occurrence of the second reduction which

* Johns Hopkins Univ. Circular, No. 6 (1909) pp. 42–5.
† Ann. Bot., xxiii. (1909) pp. 399–417 (1 pl.).
‡ Comptes Rendus, cxlix. (1909) pp. 350–2.

was discovered by Fraser in *H. rutilans* at the third mitosis in the ascus, and he finds his own results verified in three other species, *Peziza Catinus*, *Galactinia succosa*, and *Pustularia vesiculosa*.

Mildews of Cereals.*—A long series of experiments is tabulated by G. M. Reed, and results explained in connection with his work on cereals. All such experiments have in view the finding of plants immune to disease. Reed proved that mildew on oats occurs on species of *Avena* only; barley mildew only on *Hordeum*; rye mildew is confined to species of *Secale*; and wheat mildew to species of *Triticum*. An account is further given of infection experiments on hybrids of these various grasses; and, finally, in reviewing the evidence of immunity, the writer adds that external conditions play a prominent part in determining whether a plant is immune or susceptible to a given fungus-disease. The influence exerted by these conditions requires investigation.

Hypocreales of N. America: II.†—J. Seaver has united in Tribe II. Creonectrieæ, all genera and species of this group that possess a stroma. With some of these, e.g. *Sphærostilbe*, we are already acquainted; the new genera are *Sphærodermatella*, in which there is a cæspitose arrangement of perithecia; *Creonectria*, which includes the species of *Nectria* that are stromatoid; *Macbridella*, distinguished by the coloured spores; *Scoleconectria*, with elongate many-septate spores; and *Thyronectroidea*, with muriform coloured spores. All the species are fully described; none of them are new.

Xylaria polymorpha.‡—F. Guéguen reports several new observations in his cultural study of this fungus. He made cultures on carrot, and obtained stromata exactly comparable with the growths on the original wood. They were not appreciably affected by the presence or absence of light. No fructifications were obtained except from April to the end of October. Variations in form were produced owing to differences in atmospheric conditions, which explains also the variations seen in so many of the larger fungi from season to season, and should lead to caution in the determination of new species.

New Genus of Mucedineæ.§—P. Hariot and N. Patouillard received from M. Chevalier fruits of *Zizyphus Baclei* deformed by a fungus which proved on examination to be a Mucedine, *Coniodictyum Chevalieri* g. et sp. n. It is distinguished by its muriform colourless spores, yellowish-white in the mass. In the centre of the fruits there is a fine branching mycelium, from which rise short upright conidiophores, each with a muriform conidia at the tip.

Hyphomycetes.‖—In this fascicle Lindau finishes the large genus *Fusarium*. The two small sections Dictyosporæ and Staurosporæ are

* Bull. Torrey Bot. Club, xxxvi. (1909) pp. 353–88.
† Mycologia, i. (1909) pp. 177–207 (1 pl.).
‡ Bull. Soc. Mycol. France, xxv. (1909) pp. 89–97 (1 pl.).
§ Tom. cit., pp. 13–14 (12 figs.).
‖ Rabenhorst's Kryptogamen-Flora, 9te Abt. lief. 114 (Leipzig, 1909) pp. 561–624.

dealt with, and a beginning is made with the Tuberculariaceæ dematieæ, in which the fruiting body and spores are more or less dark-coloured. There are ten genera enumerated, with simple spores.

Pigment-forming Penicillium.*—H. Doebelt has investigated the formation of pigment in *Penicillium africanum*; it forms a blood-red mycelium in certain culture media, with a sulphur-yellow margin round the edge of the culture. Attention was directed specially to the connection between the substratum and the colour formation, very little colour being formed on a carbohydrate medium. Nitrogen from organic sources encouraged the red growth much more than the nitrogen of inorganic compounds. High osmotic pressure acted as a deterrent both of colour formation and of mycelial growth; high temperatures aided growth while acting unfavourably on the colour; light had no influence on the pigment; acids completely stopped the colour; oxygen was necessary for growth and for pigment. The presence of other fungi induced a more active pigment formation, and where the substratum lacked the salts necessary for the colour formation, the addition of certain fungi insured its presence.

Uredineæ.†—P. Dietel describes a number of new species. A new *Phragmidium* from Africa on *Rubus Volkensii*, with 3-celled, or, rarely, 2-celled teleutospores; other novelties are from South America and Japan—species of *Puccinia*, *Coleopuccinia*, *Coleosporium*, and *Hyalospora*.

Fr. Bubak ‡ describes a new *Æcidium* from Japan on *Scopolia japonica*, and also a *Puccinia* of the same type as *P. Poarum*. He found in the sorus two forms of teleutospore, 1- and 2-celled spores in equal proportions, both of them variable in size and form. He names it *P. cognatella*; host-plant, *Poa nemoralis* var. *umbrosa*.

A German translation § of Bubak's Rust-fungi of Bohemia has been issued. Bubak records some 312 species, and is personally responsible for most of the localities given.

A new species ‖ of *Sphærophragmium* is described by P. Hariot and N. Patouillard. It grew on one of the Anonaceæ in West Africa. A diagnosis of the species is given, with figures of teleutospores, 6-to 8-celled, and ornamented with short hairs.

F. D. Kern ¶ describes a new species of *Gymnosporangium* from Colorado, which grew on *Sabina monosperma*. The cells of the teleutospores have each five to seven large scattered germ-pores, a very unusual character, no other species having been observed with more than two.

Griffon and Maublanc** describe a new rust of orchids in hot-houses, *Hemileia Oncidii*. It forms spreading yellow patches on the leaves. The mycelium forms haustoria which pierce the cells of the host-tissue; the teleutospores are smooth, and smaller than those of *H. americana*, also a rust of orchids.

* Ann. Mycol., vii. (1909) pp. 315–38.
† Tom. cit., pp. 353–6.
‡ Tom. cit., pp. 377–9 (11 figs.).
§ Arch. Natur. Landesdur. Böhmen., xiii. No. 5, Prag, 1908. See also Ann. Mycol., vii. (1909) p. 387.
‖ Bull. Soc. Mycol. France, xxv. (1909) pp. 108–10 (1 fig.).
¶ Mycologia, i. (1909) pp. 208–10 (1 fig.).
** Bull. Soc. Mycol. France, xxv. (1909) pp. 135–9 (1 pl.)

In a further paper * they note the prevalence of cereal rusts in 1908, the year having been very damp—in one instance a third of the harvest was ruined. Notes are added on other rusts.

P. and H. Sydow † have begun the second volume of their work on Uredineæ. The first fascicle opens with the genus *Uromyces*, and contains descriptions of 218 species, arranged according to the natural orders of the host-plants. In most of them only one type of spore has been discovered. The genus resembles *Puccinia*, except that the teleutospores are usually 1-celled, and are furnished with an apical germinating pore.

J. Eriksson ‡ gives us his recent studies on specialisation in the "coronate" grass rusts. He has distinguished three forms: (1) *Puccinia coronifera*, with its æcidium, on *Rhamnus cathartica*; (2) *P. coronata* connected with *Æcidium Frangulæ*, and (3) *P. coronata* of which the æcidium is unknown; the latter grows on species of *Melica*. Accounts are given of all the cultural experiments with these different forms.

P. Magnus § points out that J. Ivar Liro, in the Uredineæ Fennicæ, has included his genus *Hyalospora* in *Uredinopsis*. The latter has a pseudoperidium in the uredo sorus which is wanting in *Hyalospora*, and there are other differences which are indicated. Magnus gives notes on the other genera of Melampsoraceæ.

G. Gassner ‖ records an epidemic of *Uromyces appendiculatus* on French beans, which practically destroyed the crop. Experiments were made with a number of varieties to test their power of resistance, but no definite results were reached.

Notes on the Larger Fungi.¶—L. Legné describes a *Morchella*-like form of *Collybia velutipes*. The hymenium covered the *Morchella*-like involutions on the upper surface of the pileus. Legné could not detect any parasitic fungus on insects that might have caused the monstrosity.

F. Hy ** contributes a note in regard to *Amanita junquillea*, which he finds edible and good, and which has been unnecessarily confused with *A. citrina*, a poisonous species. *A. junquillea* is easily distinguished by its fugacious ring, the striate margin of the large pileus and its faint but sweet odour.

W. A. Murrill †† records cases of poisoning from eating *Inocybe infida*, a small dark "mushroom." The medical symptoms are given in detail. None of the cases were very serious.

Murrill ‡‡ also describes a new species of *Boletus*, "*Ceriomyces Maxoni*," from Costa Rica, collected at approximately a height of 2000 metres among mosses on a rotten log.

César Sobrado Maestro §§ gives a list of fungi found in the neigh-

* Bull. Soc. Mycol. France, xxv. (1909) pp. 143–6.
† Monographium Uredinearum. Leipzig: Bros. Borntraeger, ii. 1 (1909) 144 pp. (5 pls.).
‡ Ark. Bot., viii. No. 3 (1909) 26 pp. (1 pl.).
§ Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp 320–7.
‖ Rev. Secc. Agr. Montevideo, iv. (1909) pp. 125–9. See also Bot. Centralbl. cxi. (1909) p. 188.
¶ Bull. Soc. Mycol. France, xxv. (1909) p. 119 (1 fig.).
** Tom. cit, p. 123–4.
†† Mycologia, i. (1909) pp. 211–14 (2 figs.).
‡‡ Tom. cit., pp. 218–19.
§§ Bol. Hist. Nat., ix. (1909) pp. 345–8.

bourhood of Santiago. He notes the capricious occurrence of certain species, some being plentiful one year and very rare another in the same locality. Most of the species were collected in pine woods.

K. Kreissler * found in a cave a monstrous form of *Polyporus Rostkovii*. He compares it with a similar form found by Reichardt in 1866, and with *Boletus rangiferinus* described and figured by Bolton.

Study of Thelephoreæ.†—W. Brinkmann writes on the changeableness of many of the species belonging to this group. Thus the thin filamentous *Corticieæ* become thick as growth proceeds: in stouter forms a new layer of basidia are formed when the first layer is exhausted—the secondary hymenia being distinguished by dark lines. In many species the surface becomes covered with warts, papillæ, or teeth, thus passing over into Hydnaceæ. The same fungi may be so different at the various stages of growth, that occasionally they are classified in different genera: thus *Peniophora crystallina* becomes known as *Odontia corrugata*. Brinkmann also draws attention to the effort made by species of this family to protect the hymenium from rain, etc. They grow by preference on the under side of logs; failing that, they develop the edge until something of a pileus nature is formed; and he also notes the tendency to form sterile growths, especially in wet weather, when species like *Peniophora byssoidea* cover large patches with their mycelium.

Researches on Fungi.‡—A. H. R. Buller has been investigating the production, liberation, and dispersion of fungus-spores, and now publishes the result of his researches in book form. The larger part is occupied with a description of spore production and dissemination in Hymenomycetes—Agarics, and Polypores. Wind or more gentle air-currents spread the spores as they fall, or, in some cases, they are eaten by slugs, and germinate after passing through the digestive tracts. Many subjects bearing on spores are dealt with, such as the specific gravity of spores, the significance of colour, and the effects of light, heat, and humidity on their discharge. Statistics are given as to the enormous numbers produced by the different fruit-bodies. Some chapters are also devoted to the Ascomycetes, in which spore-dispersion is correlated with special adaptation in the asci. The book is well illustrated and well indexed.

Java Fungi.§—M. Raciborski describes a large number of parasitic and epiphytic fungi from Java, many of them new species. There are several new genera: *Farysia* g.n., near to *Graphiola*, was found in the flowers of a *Carex*; *Ordonia* g.n., very similar to *Tomentella* and *Hypochnus*, produces globose, sessile spores, on which are formed four basidia and elongate basidiospores; *Mohortia* g.n., allied to *Septobasidium*: *Alina* g.n., near to *Balladyna*; and *Paidania* g.n., somewhat like *Venturia*, but distinguished by 2-celled spores and other characters.

* Ann. k.k. Nat. Hist. Hofmus. Wien, xxii. (1907–8) pp. 143–4 (1 pl.). See also Bot. Centralbl., cxi. (1909) p. 226.
† Bot. Zeit., lxvii. (1909) pp. 225–9, 241–5, 257–61.
‡ London: Longmans Green and Co. (1909) xi. and 274 pp. (5 pls. and 83 figs.).
§ Bull. Acad. Sci. Cracovie Cl. Sci. Math. Nat., 1909, pp. 346–94 (6 figs.). See also Ann. Mycol., vii. (1909) pp. 391–2.

Ambrosia Fungus.*—F. W. Neger has given us a second contribution on this subject. He finds that beetles as well as ants seek to obtain pure cultures of the fungus that serves them for nourishment. The ants secure this by constant weeding of their fungus gardens; the beetles by more secluded cultures, in localities free from alien infection; they never bore into trees affected by parasitic fungi. The fungi are grown in gangways and borings prepared by the beetles, who carry away the fragments of wood, and so secure a clean, well-aired habitat for the fungus, though some foreign fungi find a lodgment in the process of making the gangways. Neger has concluded that the *Ambrosia* fungus of *Hylecœtus dermestoides* is probably a species of *Endomyces*; the species of *Ceratostomella* constantly found in the borings has no connection with the *Ambrosia* fungus.

Notes on various Fungi.†—F. Theiszen gives a second series of his "Fragmenta brasilica." *Hypoxylonopsis* P. Henn. he finds to be identical with a previously described genus, *Myrmæcium*. A number of new species are described and old ones revised. He comments on the variability of the spores in *Phyllacora*, which has given rise to many species now shelved as synonyms.

Influence of Parasitic Fungi on the Form of the Host-plant.‡ Some notes on this subject are contributed by Dittrich. He finds that the disturbance of the host-tissue caused by the parasite very seldom results in any alteration of form. The changes brought about are reckoned under atrophy or hypertrophy, and both conditions may be induced on the same plant by one fungus. The most important formations are the witches' brooms, which are nearly all due to a fungoid parasite.

British Fungi.§—J. F. Rayner, in an address delivered before the members of the South-Eastern Union of Scientific Societies, advocates the study of fungi in the field as a fascinating branch of nature study. His notes on fungus-collecting have special reference to Hampshire, and he tells of the rather rare fungi that have been gathered there, the New Forest offering a fine ground for collectors. Rayner gives special attention to edible species, and concludes with advice as to the fungus-hunter's outfit.

W. M'Cutcheon ‖ publishes a list of fungi found in and around Dumfries in the months of September and October. The list is confessedly only a preliminary one, but it includes 80 species.

A. Lorrain Smith¶ also presents a list of Dumfries-shire fungi; her field of search extended to various parts of the county, and the fungi number 258 species. A sketch is also given of the conditions of climate and soil most favourable to the production of fungi.

Influence of Parasitic Fungi on Currant Wine.**— Karl Muller has tested and examined the wine made from black currants taken from

* Ber. Deutsch. Bot. Gesell., xxvii. (1908) pp. 372–89 (1 pl. and 3 figs.).
† Ann. Mycol., vii. (1909) pp. 343–53.
‡ Jahresb. Schles. Ges., lxxxvi. 2te Abt. (1908) p. 32.
§ Trans. S.E. Union Sci. Soc., (1909) pp. 15–20.
‖ Trans. Dumfr. & Gall. Nat. Hist. Soc., xx. (1909) pp. 95–7.
¶ Tom. cit., pp. 170–7. ** Centralbl. Bakt., xxiv. (1909) pp. 155–8.

bushes affected with *Glœosporium Ribis.* In the summer of 1908, all the bushes in Baden were badly attacked by this fungus, and the leaves decayed and fell by the middle of July. He found that the quantity of sugar, sap, ash, etc., was much lower in a given quantity of berries from diseased trees, but the quality was not seriously altered.

Mycological Notes, No. 32.*—C. G. Lloyd gives a sketch of the life of Elias Fries, and some information as to the work done in mycology and kindred subjects by his family. He reviews the American species of fungi in the Fries' herbarium at Upsala, many of them sent by Schweinitz, and makes notes on a number of the specimens.

Penicillium glaucum as a Cause of Pellagra.† — A. Sturli has tested the poison-producing power of this fungus as a contribution to the solution of the pellagra problem. This disease, which attacks the peasants in the Mediterranean region as well as in Austria, is due to eating diseased maize, and *Penicillium glaucum*, as the commonest fungus, has been suspected. Sturli found that the fungus cultivated on Raulin's solution was very poisonous for rabbits. The poison is neither a phenol, an acid, nor an alkaloid.

International Nomenclature.‡—P. A. Saccardo publishes a note on the question of nomenclature as applied to Cryptogams, and quotes with modified approval the decision of the Moscow naturalists that mosses should have as their initial date 1782, the date of Hedwig's work; algæ and lichens should refer back to Linnæus' Species plantarum, 1753; and fungi to Fries' Systema Mycologicæ, 1829. Saccardo reviews more recent authors, and enumerates the genera of fungi created by Persoon and others, which form the basis of all present-day work.

Plant Diseases.—A. Eichinger § writes on the skin disease of potatoes caused by *Spondylocladium atrovirens.* He failed to detect any rottenness caused by the fungus. When the tuber was directly infected, the fungi germinated and then died down, but when pieces of the fungus were placed on bits of the potato, the mycelium penetrated the flesh. The author does not consider that the fungus has any connection with *Rhizoctonia violacea.* A series of observations were made on the sensitiveness of this fungus to light during the growth period.

V. Ducomet ‖ finds a new species of *Fusarium* on *Lolium italicum*; *Sphærella pinifolia* on living needles of pine, and *Vermicularia varians* on stems, roots, etc., of *Solanum nigrum* and *Physalis peruviana.* He describes their development and the changes induced in the tissue of the host-plants. Ducomet adds notes on oak mildew.

J. G. Grozenbacher ¶ found that *Sphærella citrullina* and its pycnidial form *Ascochyta citrullina* was causing a disease of melons in Geneva

* Cincinnati, Ohio, 1909, pp. 413–24 (3 pls. and 2 figs.).

† Wiener Klin. Wochenschr., xxi. 20 (1908) pp. 711–14. See also Bot. Centralbl., cxi. (1909) pp. 139–40.

‡ Ann. Mycol., vii. (1909) pp. 339–42.

§ Ann. Mycol., vii. (1909) pp. 356–64 (3 figs.).

‖ Ann. École Agric. Rennes, ii. 1908 (1909) 94 pp. (53 figs.). See also Ann. Mycol., vii. (1909) p. 388.

¶ Exper. Stat. Techn. Bull., No. 9 (1909) pp. 195–229 (6 pls.). See also Ann. Mycol., vii. (1909) p. 389.

(New York). Notes are given of the examination of the fungus, and as to the method of stamping it out.

G. Trincheri* publishes a preliminary account of microfungi found on ornamental trees in the botanical gardens at Naples. Several of the species described are new to science.

Griffon and Maublanc † give an account of the rapid spread of the oak mildew. They offer several theories as to the origin of the fungus. Either it is an indigenous European form that has taken on a new vitality, or it is an alien form that has been introduced, probably from North America. The authors consider that it cannot be referred to the genus *Phyllactinia*.

The same authors ‡ have studied a disease of cocoa affecting the branches and roots. It is caused by the fungus *Lasiodiplodia Theobromæ* previously described under various other names. It is one of the Sphæropsideæ with compound pycnidia.

In another paper § they describe several new species of parasitic fungi: *Colletotrichum Ixoræ* on the leaves of *Ixora*; *Dichomera Carpini* on branches of *Carpinus*; *Næmaspora Jasmini*, differing from other species of the genus in the irregular ovoid spores which are pale rose-coloured in the mass; and *Chætophoma erysiphoides* on leaves of *Quercus Ilex*. Notes are also given on some previously known fungi.

A disease of cotton that affected the plantations in Dahomey has been diagnosed by G. Fron ‖ as due to a fungus *Phoma Roumii* sp.n. When young branches are attacked growth ceases and the branches die off.

Diseases of beetroot have been specially studied by Griffon and Maublanc.¶ Their observations extended over two years, one very dry, the other very rainy, and they were thus able to test the importance of atmospheric conditions. They distinguish three forms of attack by fungi. 1. Rottenness of the heart-leaves caused by various fungi, but due principally to the soil. 2. Disease of the outer leaves: rust (*Uromyces Betæ*), mildew (*Peronospora Schachtii*), and spots (*Cercospora beticola*). The leaves are also subject to the depredations of *Ramularia beticola*. 3. Diseases of the beetroot caused by *Urophlyctis leproides* and also by *Rhizoctonia* and *Phoma*. Proliferations of the roots is a serious trouble of which the cause is still obscure, but it seems proved that they are not caused by animal or vegetable parasites.

The same authors ** report on some diseases of the vine, notably mildew, and they recount the experiment of treating it with a wash of sea- or salt-water. It was to a certain extent effective, but it does not kill all the conidia nor the mycelium, and if the solution is too strong the leaves are injured. Black-rot (*Guignardia Bidwellii*) is also a troublesome disease, but less prevalent than mildew, as it requires excessive moisture for its development.

A disease of the coffee plant †† has been diagnosed by F. H. d'Herelle

* Rend. R. Accad. Sci. Fis. Mat. Napoli, fasc. 3–4 (1909) 7 pp. See also Ann Mycol., vii. (1909) p. 393.

† Bull. Soc. Mycol. France, xxv. (1909) pp. 37–50.

‡ Tom. cit., pp. 51–8 (2 figs.).

§ Tom. cit., pp. 59–63 (3 figs.).

‖ Tom. cit., pp. 66–8 (4 figs.).

¶ Tom. cit., pp. 98–107 (4 figs.).

** Tom. cit., pp. 140–3.

†† Tom. cit., pp. 171–85 (1 pl.).

to be due to a Pyrenomycete, *Phthora vastatrix* g. et sp. n. The first symptoms are the raising of the bark at the base of the trunk, which then splits and sometimes comes off. The tree is killed by the hyphæ hindering the circulation of the sap, and by the destruction of the cambium. Infection takes place on the roots, especially of the older trees. Shade trees are also attacked by the same fungus, though its action on these trees is slightly different. Conidia and spermogonia are formed, as well as perithecia.

N. A. Cobb * has published a pamphlet which gives an account of troublesome diseases in Hawaii, most of them fungoid diseases, and especially affecting the culture of the sugar-cane. *Ithyphallus*, *Clathrus*, and *Dictyophora*, all genera of the Phalloideæ, infect the roots of the cane. These are fully described and compared. Diseases of the leaves caused by microscopic fungi, are also noted, *Leptosphæria Sacchari*, *Cercospora Sacchari*, etc. Cobb gives his method of treating these various diseases. A section of his work deals with timber-rots, caused also by fungi, among others *Lepiota cepæstipes* and a yellow-spored agaric; the effects produced by these fungi are described. Cobb estimates the spores from one pileus of the yellow agaric as somewhere over 300,000,000.

A disease of varions species of *Ribes* is described by T. Wulff † as due to *Botrytis*. Leaves and fruit are attacked and badly damaged; the former are inoculated through the stomata, the fruit probably through some small wound. Sclerotia are formed on the decaying fruits, but no ascomycetous form has been noticed; probably it is a form of *Sclerotinia Fuckeliana*.

Von Faber ‡ reviews the diseases to which the cotton-plant is subject; the roots are often attacked by *Neocosmospora vasinfecta*, first detected in N. America; it entirely destroys the roots. A species of *Diplodia* also attacks the roots that have previously suffered from *Neocosmospora*, and another species of *Diplodia* destroys the leaves. Faber gives a series of fungi, *Puccinia*, *Cladosporium*, etc., that destroy either the foliage, leaves, or the flowers; the destruction of the capsules called "black-boll" is probably due to bacteria.

E. Rehm § writes on the occurrence of black-scab in potato in England; he points out the confusion that has arisen in the determination of the fungus *Chrysophlyctis endobiotica*, and gives an account of the methods used for its extermination. A bibliography of the literature on this subject is added.

Carlo Tiraboschi ‖ has examined by means of cultures the different fungi that are to be found on diseased maize. There are species of *Oospora*, *Penicillium*, *Aspergillus*, *Hormodendron*, and *Diplodia*. He describes the appearance and gives biological details of these fungi.

Wood-destroying fungi have been studied by Otto Bittmann,¶ both

* Exper. Stat. Hawaiian Sugar Pl. Assoc., Bull. No. 6 (1909) 110 pp. (7 col. pls. and 64 figs.).

† Ark. Bot. viii. No. 2 (1909) 18 pp. (2 pls. and 4 figs.).

‡ Centralbl. Bakt., xxiv. (1909) pp. 196–8. § Tom. cit., pp. 208–13.

‖ Ann. Botanica, vii. (1908) H. 1. See also Centralbl. Bakt., xxiv. (1909) pp. 264–7.

¶ Oesterr. Forst. Jagdzeit, xxvii. (1909) pp. 74–6, 84–5, 95–6, 135–6. See also Centralbl. Bakt., xxiv. (1909) pp. 303–4.

parasitic and saprophytic. Agarics infect poplar wood at the saw-mills. Purple willow is attacked in Lower Austria by *Cenangium rosulatum*; an Ascomycete, *Collybia velutipes*, is suspected of causing a disease of elms in the water meadows of Moravia. On barked oak appear *Stereum hirsutum*, *Polyporus hirsutus*, *Lenzites betulina*, and *Bulgaria polymorpha*. A species of *Clavaria* follows on the attack of a beetle.

H. Nilsson-Ehle * has made a study of the *Scolecotrichum*-disease of oats. It appears more frequently on moorlands, and more especially after a dressing of lime. Susceptibility to the disease lies in the oats themselves. Descriptions of those that are susceptible and those that are immune are given.

C. Reiche † gives an account of the diseases that attack cultivated plants in Chili. The chief fungoid parasites are smuts and rusts on cereals. *Helminthosporium gramineum* on barley, etc. Peronosporeæ are rare owing to the dry summers. On orchard trees, *Exoascus deformans*, *Fusicladium*, *Nectria* and *Cycloconium* are the most frequent; on the vine, *Oidium Tuckeri*. The insect pests are also enumerated.

G. Gassner ‡ combats the view that the witches' brooms of cherry in Uruguay are due to temperature. He points out that the disease is due to *Exoascus deformans*, and advises as to methods of treatment.

Mycorhiza as a Parasite. § — G. A. Nadson investigated an extensive loss of oak-seedlings, 1–2 years old, and found that the roots had been killed by a mycorhiza fungus. The hyphal cells of the parasite were here and there much enlarged, and not only was it of no use to the oak, but had become a dangerous disease. The author states all such fungi are parasites, but usually the parasitism is confined to the outer cell-layers of the root, and the fungus takes over the function of providing water and food materials, thus giving rise to the symbiotic conditions. Occasionally, as in the case investigated, the fungus becomes a pure parasite.

ATKINSON, GEO. F.—**Preliminary Notes on some New Species of Agaricaceæ and Clavaria.** *Ann. Mycol.*, vii. (1909) pp. 365-76.

BAINIER, G., & A. SARTORY—**Étude d'un Aspergillus pathogène (Aspergillus fumigatoides sp.n.)** (Study of a pathogenic *Aspergillus*.)
[Description of the new plant, and its effect on inoculation experiments.]
Bull. Soc. Mycol. France, xxv. (1909) pp. 111-18 (1 pl.).

BATAILLE, FRÉDÉRIC—**Miscellanées mycologiques.**
[Diagnoses of two species of *Cortinarius*; notes on colour reactions and a species of *Russula*.) *Tom. cit*, pp. 69-82.

BOURDOT, H., & A. GALZIN—**Hymenomycetes de France.**
[Patouillard's classification has been followed, and a critical account of the plants is given.] *Tom. cit.*, pp. 15-36.

* Tiddskr. Landt. Lund, 1908, 15 pp. See also Bot. Centralbl., cxi. (1909) p. 165.

† Contr. Centro. Ind. Agric. Congr., iv. (1908) pp. 163–6. See also Bot. Centralbl., cxi. (1909) p. 166.

‡ Rev. Asoc. Rural, Uruguay, Montevideo, 1908, pp. 546–51. See also Bot. Centralbl., cxi. (1909) pp. 188–9.

§ Jahrb. Pflanzenkr. St. Petersbourg, ii. (1908) pp. 26–40; Rés., pp. xi–xii (4 pls.). See also Bot. Centralbl., cxi. (1909) pp. 165.

BUBAK, FR.—**Eine neue Tilletia-Art.** (A new species of *Tilletia*.]
[The fungus grew in the fruits of *Hordeum vulgare*, filling them with violet spores.]
Zeitschr. Landw. Versuch. Oesterr., 1909, pp. 545–49 (1 fig.).
See also *Ann. Mycol.*, vii. (1909) p. 387.

CHALTON. ED., & F. PICARD—**Contribution á l'étude systématique et biologique des Laboulbeniacées.**
[*Trenomyces histophtorus* sp. n. is described, and a general account of Laboulbeniaceæ is given.]
Bull. Soc. Mycol. France. xxv. (1909) pp. 147–70 (2 pls. and 5 figs.)

FERDINANSEN, C., & O. WINGE—**Two New Fungi collected by F. Börgensen in the Spanish West Indies.**
[Species of *Eutypella* and *Dothiorella*.]
Vid. Med. Nat. For. Köbenhavn, 1908.
Copenhagen, 1909, pp. 141–4 (1 pl.).
See also *Bot. Centralbl.*, cxi. (1909) p. 186.

„ „ „ **Mycological Notes II. A. Danish Fungi.**
[Descriptions of culture experiments with *Cladochytrium*, and diagnoses of new species.]
B. Three new Foreign Species.
[Parasites on various plants.]
Bot. Tidsskr., xxix. (1809) pp. 303–19 (8 figs.).

FERNBACH, A. — **Sur un poison élaboré par la levure.** (A poison formed by yeast.)
[A toxic substance was extracted from dried yeast.]
Comptes Rendus, cxlix. (1909) pp. 437–9.

FONTANA, EFISIA—**Recerche intorno ad alcune specie del genere Elaphomyces Nees.** (Study of some species of *Elaphomyces*.)
[A thorough study of *E. variegatus* and *E. granulatus* and allied forms.]
Mem. Reale Accad. Sci. Torino, ser. 2, lix. (1909) pp. 89–108 (2 pls.).

GILLOT, X. — **Deformation coralloide du Polyporus umbellatus.** (Coralloid deformation of *Polyporus umbellatus*.]
[The fungus was growing in the gallery of a mine.]
Bull. Soc. Mycol. France, xxv. (1909) pp. 64–5 (1 pl.).

HÖHNEL—**Mykologisches. XXII.**
[An account of the larger fungi of the Austrian Alps, collected in August and September.]
Oesterr. Bot. Zeitschr., lix. (1909) pp. 62 and 108.
See also *Bot. Centralbl.*, cxi. (1909) p. 103.

JACZEWSKI, A. A.—**Mykologisches Flora des europäischen und asiatischen Russlands. II. Myxomycetæ.** (Mycological flora of European and Asiatic Russia. II. Myxomycetes.)
[The author records three genera of Acrasieæ, and 35 genera of Mycetozoa, with 100 species.]
Materialen zur Kennt. Faun. Fl. Russ. Reiches, Bot., vi. (Moskau, 1907) pp. 1–140 (84 figs.). See also *Bot. Centralbl.*, cxi. (1909) pp. 105–6.

KEISSLER, K. VON—**Ueber Sclerotinia echinophila Rehm.**
[The writer found the first-formed fruits long-stalked and light-coloured, the later-formed short and dark.]
Ann. k.k. Naturf. Hofmus. Wien, xxii. (1907–8) pp. 145–6.
See also *Bot. Centralbl.*, cxi. (1909) p. 226.

LAGERHEIM, G.—**Verzeichnis von parasitischen Pilzen aus Södermanland und Bohuslän.** (List of parasitic fungi from Sodermanland and Bohuslan.)
[The writer enumerates 118 species, with hosts, etc., and gives notes on Uredineæ and Ustilagineæ.] *Svensk. Bot. Tidskr.*, iii. (1909) pp. 18–40.
See also *Bot. Centralbl.*, cxi. (1909) p. 228.

MARTIN, CH. ED.—**Herborisation mycologique aux environs de Perrignier.**
[Description of species of fungi found in Upper Savoy.]
Bull. Herb. Boiss., ser. 2, viii. (1908) pp. 974–5.
See also *Bot. Centralbl.*, cxi. (1909) p. 104.

MIGULA, WALTER—**Flora von Deutschland.**
[Four fascicles dealing with the Oomycetes and Zygomycetes.]
Krypt. Flora, v.–viii., fasc. 76–9 (1909) pp. 177–240 (20 pls.).

MOESZ, G.—**Magyarország Cordyceps-ei.** (*Cordyceps* species in Hungary.)
[Critical account of several species.]
Bot. Közlem, No. 2 (1909) 15 pp. (1 pl.).
See also *Ann. Mycol.*, vii. (1909) p. 390.

PATOUILLARD, N. — **Quelques Champignons de l'Annam.** (Some fungi from Annam.)
[The fungus flora is very like that of the Conifer woods in hilly regions of Europe and North America. Several new species are described.]
Bull. Soc. Mycol. France, xxv. (1909) pp. 1–12 (2 pls.).

,, ,, **Champignons de la Nouvelle Calédonie.**
[An account of the genus *Trichoglossum* Bowd and of *Le Ratia smaragdina* sp. n.]
Tom. cit., pp. 129–34.

POTEBNIA, A.—**Zur Entwickelungs-geschichte einiger Ascomyceten.**
[Development of some Ascomycetes: (1) *Mycosphærella*, (2) *Gnomonia*, *Glomorella*, and *Pseudopeziza*. The author proposes a scheme of classification of the fungi imperfecti based on this relationship with higher forms.] *Trav. Soc. Nat. Univ. Imp. Kharkov*, xlii. (1908) 154 pp. (63 figs.). (Russian.)
See also *Bot. Centralbl.*, cxi. (1909) pp. 163–4.

PRINGSHEIM, H.—**Der Einfluss der chemischen Konstitution der Stickstoffnahrung auf die gärfähigkeit und die Wachstumsenergie verschiedener Pilze.** (The influence of the chemical constitution of nitrogenous nourishment on the fermentative power and the growth force of different fungi.)
[Certain molecules of the Amino-acid group must be present in the nitrogenous substances to produce fermentation.]
Biochem. Zeitschr., viii. (1908) pp. 119–27.
See also *Bot. Centralbl.*, cxi. (1909) p. 305.

SUMSTINE, D.—**Four interesting Species of Moulds.**
[Species of Mucorini collected at the New York Bot. Garden.]
Mycologia, i. (1909) p. 218.

THEISSEN, F.—**Xylariaceæ Austro-brasilienses. I. Xylaria.**
[An account of the *Xylariæ* of South Brazil; 41 species are recognised.]
Denkschr. Math. Nat. Kl. k. Akad. wiss. Wien, lxxxiii. (1909) pp. 47–86 (11 pls. and 7 figs.).
See also *Ann. Mycol.*, vii. (1909) pp. 392–3.

TRANZSCHEL, W. — **Revision der in Central-Asien von Herrn Ove Paulsen gesammelten Uredineen.** (Revision of the Uredineæ collected in Central Asia by Ove Paulsen.)
[The plants were named by E. Rostrup, and have been revised by Transchel; a few corrections are noted.] *Bot. Tidsskr.*, xxix. (1909) pp 154–7.

WHELDON, H. J.—**Some Highland Fungi.**
[Fungi collected in the Cairngorm mountains in July.]
Journ. Bot., xlvii. (1909) pp. 348–9.

WILDEMAN, EM. DE—**Flore du bas- et du moyen-Congo.** Flora of the lower and central Congo.)
[A list of leathery or woody fungi and of microfungi; several new species are described from notes left by the late P. Hennings.]
Ann. Mus. Congo Belge, ser. 5, 111, fasc. 1, pp. 1–22.

Lichens.

(By A. Lorrain Smith.)

Physiological Importance of Algæ and Fungi in Lichens.*—F. Tobler remarks that, though the separate components of lichen thallus have been long proved, little is known as to the role which each plays in regard to the other. It is desirable to know in what manner, and how far the growth of the fungus is affected by the composite life. Tobler carried out culture experiments on the alga and fungus of *Xanthoria parietina*, and gives an account of his culture methods. He was able to produce a growth of mycelium from the spores without any admixture of algæ, but in such growth there was never any trace of the lichen substance "parietin," so characteristic of the normal thallus. When the mycelium had algæ added to it, traces of the parietin were formed. The author proposes to continue his studies on the same lines.

New Instances of Parasymbiosis.†—The name Parasymbiosis was given by Zopf to the case of those fungi that lived on the thallus of lichens, associated with the algæ, and doing no damage to either thallus or fruit of the host-plant. Zopf proved this for several so-called parasitic fungi, and now Ignaz Kotte has taken up the research with reference to *Abrothallus*, which he treats as a fungus, though by some considered as a lichen. He was able to trace the course of the alien hyphæ in the thallus, as they took a blue coloration with iodine, while the host hyphæ remained unaffected. Kotte was able to verify Zopf's observations in regard to a symbiotic relationship between the hyphæ of the parasite and the algæ of the host, the algæ remaining healthy: he also traced the hyphæ into the soredia and isidia of the host: and on the dispersal of the soredia it is presumed that portions of the *Abrothallus* hyphæ are carried away and develop along with the new plants. There are five species of *Abrothallus* on different lichens belonging to the genera *Cetraria* and *Parmelia*. Rehm had included them all under *Abrothallus Parmeliarum*. In two of the species—one on *Cetraria glauca*, another on *Parmelia saxatilis* and *P. conspersa*—the hyphæ are not stained blue with iodine.

Malme, G.—**Lichenes suecici exsiccati, Fasc. iii.–iv.**
[Includes 50 numbers; some of them rare species.]
Stockholm, 1908. See also *Bot. Centralbl.*, cxi. (1909) p. 252.

Wainio, Ed.—**Flora of Koh Chang: Contributions to the Knowledge of the Vegetation in the Gulf of Siam. Lichenes.**
[A list of 95 species, a few of them new to science; all of them with full diagnoses.] *Bot. Tidsskr.*, xxix. (1909) pp. 104–51 (1 pl.).

Zahlbruckner, A.—**Lichenes rariores exsiccate. Decades xi.–xii.**
[Includes lichens from Germany, Austria, France, and North and South America.]
Vienna, 1909. See also *Bot. Centralbl.*, cxi. (1909) p. 275.

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* Ber. Deutsch. Bot. Gesell., xxvii. (1909) pp. 421–7 (1 fig.).
† Centralbl. Bakt., xxiv. (1909) pp. 74–93 (3 pls. and 1 fig.).

Schizophyta.

Schizomycetes.

New Hæmophilic Bacterium.*—U. Paranhos has isolated from the cerebrospinal fluid of a boy with symptoms of meningitis an organism that only grew on blood-agar; it appeared on this medium, after 48 hours' incubation, in small round colonies, without any discolouring of the medium; the most favourable temperature was 37° C., and no growth occurred under 25° or over 40° C. The colonies were composed of small non-motile bacilli, twice as long as their breadth, either straight or slightly curved, and with a small clear interspace in the middle; the bacilli have neither capsule nor flagella, and do not form spores: they stain with ordinary anilin dyes and by Gram's method, and are not acid-fast; pathogenicity was shown in a pigeon, but dogs, rabbits, and guinea-pigs gave negative results.

Nitrogen-fixing Bacteria and Non-leguminous Plants.†—W. B. Bottomley finds that mixed cultures of *Pseudomonas* and *Azotobacter* incubated in flasks containing a medium composed of maltose, potassium phosphate, sodium chloride, calcium carbonate, ferrous sulphate, agar and distilled water, at 24° C. for 15 days (care being taken to renew the air in the flask at intervals), have combined with more free nitrogen than similarly treated cultures of *Pseudomonas* alone.

The author planted oat seeds in four pots of sand, with sufficient phosphate, potash, and lime; when the plants were 1 in. high, two pots were watered with mixed cultures of *Pseudomonas* and *Azotobacter*; the plants were kept watered with distilled water and allowed to grow until the untreated plants drooped; after drying it was found that the treated plants weighed 76 p.c. more than the untreated.

Ratin bacillus and Bacillus enteriditis Gaertner.‡—F. Lebram has studied the ratin bacillus, and finds that it bears a strong similarity both in pathogenic and cultural characters to *B. enteriditis* Gaertner. On litmus-agar plates they both form small blue colonies; they ferment glucose broth with the production of gas; both redden litmus milk, *B. enteriditis* more strongly at first, and becoming blue after 5 or 6 days, whereas the red formed by the ratin bacillus remains constant for several weeks. Both organisms ferment neutral-red agar with the production of fluorescence: neither liquefy gelatin; with both, broth cultures are uniformly clouded, but with Gaertner bacillus the medium clears in 2 to 3 days with the formation of a deposit; with the ratin bacillus the medium forms a pellicle and clears only after 7 days; neither organism coagulates milk, but the medium becomes yellow and translucent after 2 to 3 weeks; with Gaertner serum the ratin bacillus gives a positive agglutination in dilutions of 1 in 5000: with ratin serum the Gaertner bacillus gives a positive agglutination in dilutions of 1 in 2000.

Avian tuberculin and Pseudo-tuberculous Enteritis of Cattle.§ O. Bang found in cases of pseudo-tuberculous enteritis of cattle a bacillus which is acid-fast and resembles the tubercle bacillus, and the lesions

* Centralbl. Bakt., 1te Abt. Orig., l. (1909) p. 607.
† Proc. Roy. Soc., lxxxi. (1909) p. 287.
‡ Centralbl. Bakt. 1te Abt. Orig., l. (1909) p. 315.
§ Op. cit., li. (1909) p. 450.

produced by it are very similar to those of true tuberculosis. The author also found that the animals affected with the disease react to avian tuberculin in the same way as a tuberculous animal reacts to tuberculin.

Morphology and Biology of the Whooping-cough bacillus.*—W. N. Klimenko has studied the whooping-cough bacillus of Bordet and Gengou. The organism appears as small round-ended non-motile rods, occasionally arranged in pairs united at their extremities, and also in chains when grown in milk ; the rods are larger when grown in fluid than in solid media ; involution forms are rare, but occur in pepton-water ; the bacillus has no capsule and does not form spores ; it does not stain by Gram's method, and is not acid-fast ; it stains a lilac tint with methyl- and toluidin-blue ; bipolar staining is best shown with carbol-toluidin-blue.

The organism is obtained in greatest numbers during the catarrhal phase, or the first week of the spasmodic stage of the disease ; cultivations are made from sputum, washed with sterile salt solutions, and spread on plates of potato-glycerin-blood-agar ; the colonies, which appear after 2 days' incubation, are round, colourless, and refractile, and show a strong hæmolytic action ; with glucose and glycerin there is no production of gas ; on gelatin it forms a grey opalescent growth, and does not liquefy the medium ; on potato the growth is shining and greasy and of a brown colour ; in ordinary broth there is clouding and a production of slime ; on 1 p.c. pepton-water growth is less vigorous and no slime is formed ; when grown on milk the medium becomes cleared, of a yellow or yellow-brown colour, and strongly alkaline ; there is no indol formation ; the organism appears to form an endotoxin pathogenic for young dogs, cats, monkeys, mice, guinea-pigs, and pigeons, but less so for rabbits, goats, horses. and for full-grown dogs and cats. Immune sera obtained from rabbits and dogs had but slight active agglutinating properties. Cultures retained their vitality for a month on blood media, 10 to 14 days on gelatin, 3 to 4 weeks on agar, and in broth for 30 to 40 days.

Life Cycle of Bacillus Nitri sp. n.†— A. Ambrož isolated this organism on gelatin plates prepared to isolate Saccharomycetes from a 5 p.c. solution of sodium nitrate ; the author regards the organism as a new species. It appears as stout rods 3–8 μ long, and width about one-third of the length ; in broth it is shorter and stouter ; on potato and on solid blood serum long, thin, thread-like forms are met with ; it produces a yellow-brown pigment in its late development, especially on potato, but also on agar and sugar-agar ; on gelatin it forms white regular kidney-shaped colonies, the medium being quickly liquefied ; growth on Endo's medium has a faint rose colour ; it does not grow on Drigalski's medium ; in milk it produces acid, but there is no clotting ; in broth it forms a slight pellicle, and also a sediment ; the optimum temperature is between 35° C. and 47° C. ; when grown on potato it has a strong tendency to form spores.

The method of observation employed by the author consisted in fixing with HCl_2 solution, staining with Giemsa's stain for about an hour, and thoroughly decolorising with alcohol. In the early developmental state the bacillus has a homogeneous appearance ; in agar cultures the rods multiply by division, which commences by the formation of

* Centralbl. Bakt., 1te Abt. Orig., li. (1909) p. 305. † Tom. cit., p. 193.

deeply staining granules about the middle of the rod, which, uniting with the outer membrane, constitute the dividing line; the newly separated ends appear thick and densely stained; later forms show that the homogeneous structure has altered to various forms of chromatin network, with deep violet-stained nodes and vacuoles. Sporulation commences by a condensation of the chromatin mass, and the differentiation of the fertile pole; this last is unstained, and is recognised by its faint lustre, which later becomes more intense, and a network structure, the nodes of which are densely violet stained chromatin granules, which gradually disappear and leave an enlarged unstained spore, microchemically corresponding to plastin.

Coagulation of Condensed Milk.*—R. Greig Smith has shown that the coagulation or jellifying of condensed milk is due to an infection by a micrococcus. The nature of the substance that forms the jelly is not a slime or gum derived from the saccharose or lactose through the biochemical activity of the microbe, but is an altered condition of the casein resulting from the action of an enzyme secreted by the organism.

The micrococcus measures 1 μ, and stains by Gram's method; on agar it forms a porcelain-white raised glistening growth; in broth it forms turbidity and a coherent sediment; there is formation of indol, and nitrates are reduced to nitrites; on potato it forms a moist, transparent growth; gelatin is slowly liquefied; no gas is formed from glucose. The organism resembles *Micrococcus pyogenes albus* Rosenbach, but it is not pathogenic to mice.

Movement of Bacteria.†—K. Reichert, by means of a simplified ultramicroscope apparatus, has demonstrated the flagella of many varieties of bacteria in unstained condition. The best medium for these demonstrations is agar condensation water, or fluid nutrient (1 p.c.) gelatin. For studying the conditions that regulate the visibility of flagella on dark field illumination, the author chose *Spirillum volutans*. It was shown that neither the optical nor the osmotic relations of the swimming medium have any influence, but the chemical properties of the substances dissolved in the medium are of much more consequence.

Influence of Organic Substances on the Culture of Nitrifying Organisms.‡—J. Makrinoff has shown by a number of cultural experiments that when pure cultures of nitrifying organisms are plated on solid medium composed of gypsum and magnesium carbonate, a much more abundant and more energetic growth is obtained if soil rich in organic matter, or dried and powdered leaves, are mixed with the medium. If, however, the same organic material is added to a fluid medium, the growth of the nitrifying organisms is less.

Bacillus mycoides Flugge.§—K. Holzmuller has studied eight organisms, viz.:—*B. mycoides* (α), (β), (γ), and (δ), *B. effusus*, *B. olfactorius*, *B. nanus*, and *B. dendroides*, all of which are nearly allied to *B. mycoides* Flugge, differing from it and from each other in the character of their spores, and in the appearances of their cultures.

* Proc. Linn. Soc. N.S.W., xxxiv. (1909) p. 167.
† Centralbl. Bakt., 1te Abt. Orig., li. (1909) p. 14.
‡ Op. cit., 2te Abt., xxiv. (1909) p. 415.
§ Op. cit., xxiii. (1909) p. 304.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Dissecting Stand, with Lens.†—This instrument (fig. 118) consists of a heavy cast-iron base supporting a brass pillar about 13·5 cm. high.

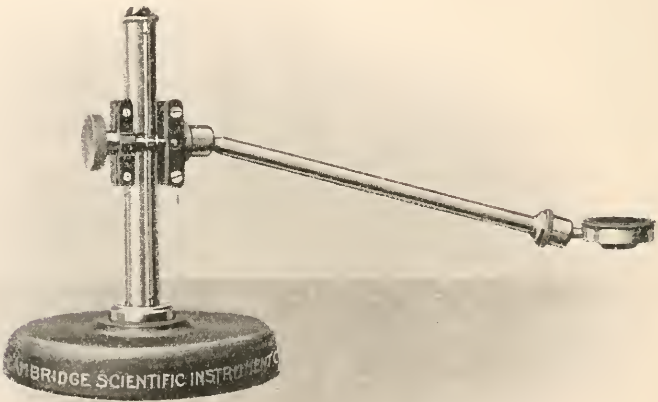

Fig. 118.

On this pillar a carriage slides up and down. This up and down movement is secured by Lucas's patent slow motion mechanism, which

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives: (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Cambridge Scientific Instrument Co., Ltd., Cat. No. 57 (1909) p. 10, fig. 11.

consists of a small pulley with a V-groove being forced by a spring to bind on a round steel rod, which is screwed to the main pillar. This results in a far nicer movement than the rack-and-pinion gives, since a geometric fit is obtained, and there can be no play or backlash. The movable carriage carries through a ball-joint an arm, at the far end of which the lens-holder is mounted, a ball-joint being used here also. The total length of the arm from the centre of the pillar to the centre of the lens is 23·6 cm.

Koristka's Large Model I.*—This stand (fig. 119) is specially constructed for photomicrography. The upper part is inclinable to 90°, and can be fixed in any position by means of a clamp. There is a mechanical stage with ample vertical and horizontal movements, and the substage arrangements are very complete.

REICHEL, C.—**Das Mikroskop als Hifsmittel in der Werkstatt.**
[The author points out how a Microscope of small magnifying power (10 diam.) may be made very useful in checking the accuracy of fine machine work.] *Deutsch. Mechan. Zeitschr.*, 1909, p. 1.

(2) Eye-pieces and Objectives.

Improved Triple Object-glass.†—Although J. W. Gifford designed this object-glass for a telescope, yet the method of its construction will be interesting to microscopists. The principle, briefly put, is the construction of a single compound lens out of three varieties of glass so selected that three rays of the solar spectrum (B, D and C) are combined, and that therefore perfect achromatism as regards those rays is obtained. An essential preliminary was the determination of the refractive indices of suitable glasses to the utmost accuracy. It was found that indices extending to five places of decimals were insufficient, and the author carried his observations to seven places.

The author had already previously described‡ a method by which the optical constants of glasses can be very accurately measured. To obtain the refractive index it is necessary not only to measure the deviation of the ray from the normal due to the action of the angle of the prism through which it has passed, but also to measure the angle itself, an operation far more liable to error than measuring the deviation. To avoid this the prism is polished on all three sides, the deviations are measured at all the angles, are added together, and the mean deviation, on the principle that the three angles of every triangle are always equal to two right angles (180°), may be used for the purpose of calculating the refractive index as being the deviation for an angle of 60°, although no angle has actually been measured.

The method is not absolutely correct, but the average error due to the method is less than unity in the seventh decimal place. This error is caused by the three angles not being quite equal to one another, but as, with measurements by the ordinary method, it is difficult to avoid error even in the fourth decimal place, it will be readily seen that for all practical purposes considerably greater accuracy is obtained. The

* Koristka's Catalogue, xiii. (1908) pp. 8 and 9, fig. 3.
† Monthly Notice, Roy. Astro. Soc., lxix. (1908) pp. 118–25 (1 pl. and 2 figs.). See also The Observatory, Jan. 1909, pp. 41–2.
‡ Proc. Roy. Soc., Feb. 13, 1902.

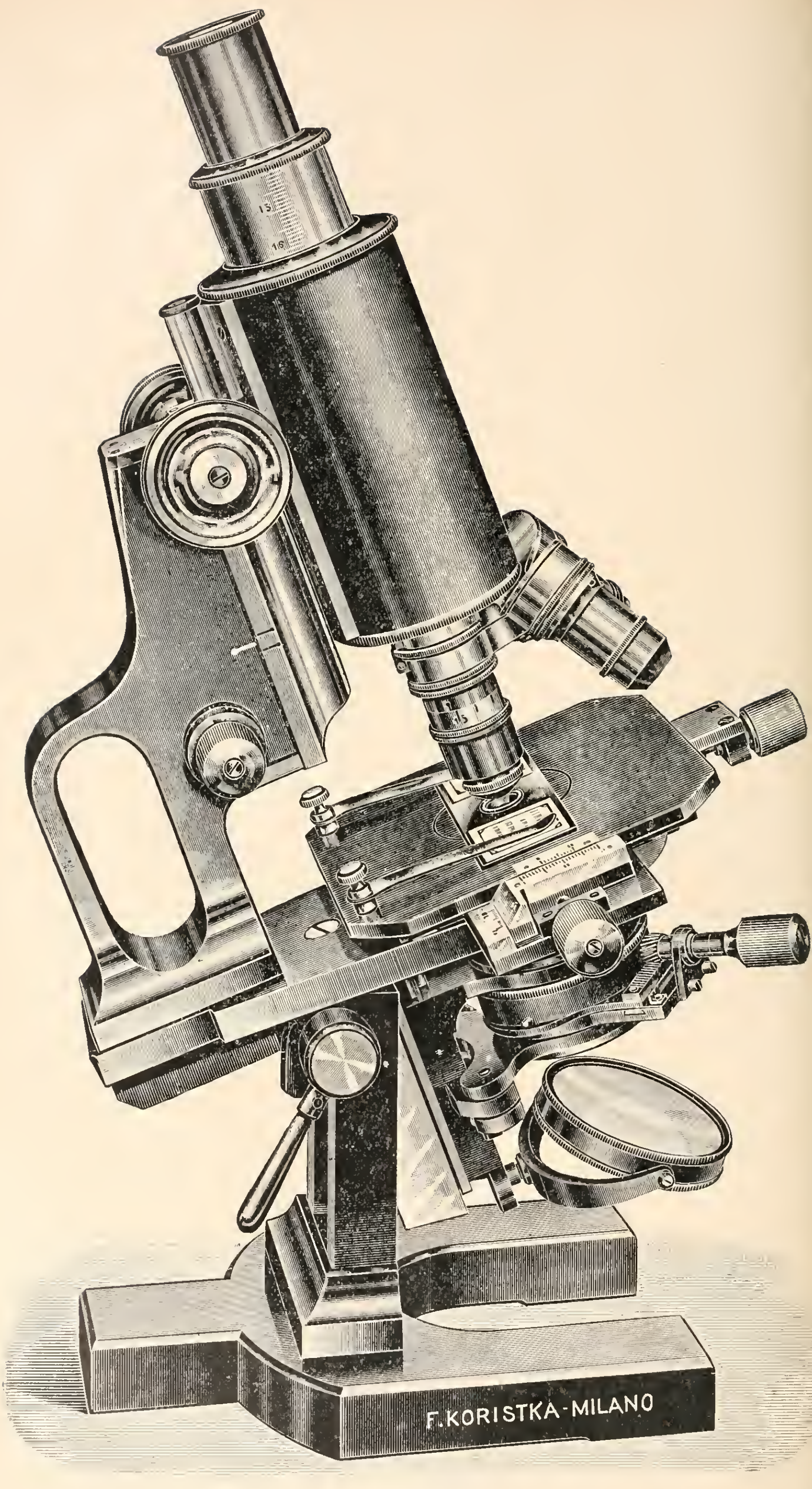

Fig. 119.

measurements of deviation are also made more accurate by taking advantage of the two burrs thrown up by the engraving-tool on each side of every division of the goniometer circle. These are so illuminated as to appear as two fine white lines, and a quartz fibre being brought over each in turn, the mean reading is taken.

In order to get thoroughly representative figures for each glass-melting (about 150 lb. weight), three pieces are chosen at hazard from different parts of it, and these are made into prisms. The average index is then taken as that of the melting, each prism having been measured as to deviation as stated.

Finally, the author checks the errors of his working instrument by comparing the indices with those of a larger goniometer having an 18 in. circle and object-glasses of 3 in. aperture and 30 in. focus. There is also a careful correction for temperature. By the method described it is considered that another decimal place is gained.

Prof. Hastings having long since given as his opinion* that the inconsistencies in his results in the calculation of objectives made of three separate glasses were due to want of accuracy in the refractive indices, Mr. Gifford has made a comparison of the optical constants sent out with the glasses by the makers with those found by his method as well as with the results obtained with them. He finds that the triple is so sensitive to variation of index that, in the case in point, if four decimal places only, instead of five, are taken in the index, then the focus of one of the component lenses, from being positive, becomes a minus quantity. Hence it is quite imperative that the refractive indices should be carried to as many decimal places as the accuracy of the deviations warrants.

Lines B, D, and G of the solar spectrum were used as a basis of calculation for some of the earlier triples. Mr. Gifford uses B′, a red helium line, Λ, a lead line, and Φ, the 6th cadmium line, the two latter being respectively the visual and photographic maxima for rays which have passed through the glasses used. By employing these he gets the further advantage of shallower curvatures.

The paper goes on to describe a lens actually constructed, and concludes with an appendix giving the formulæ for the first approximation and for the trigonometrical trace of a ray, as well as a diagram of the curve of focal lengths of the triple for the different wave-lengths as compared with those of a doublet. The trigonometrical trace is, with very slight modifications, applicable to object-glasses for the Microscope.

The following will illustrate the author's method of finding the reciprocals of the foci for the apochromatic triple :—

μ is baryta light flint ; μ' is borosilicate flint ; μ'' is borosilicate crown. The differences of proportional spectra are : Λ′ − D, 0·00168 ; D − F, − 0·00030 ; F − G′, 0·00805. The refractive indices are :—

B′, 7066 (He)	Λ, 5607 (Pb)	Φ, 4678 (Cd_6)
$\mu_1 = 1·569074$	$\mu_2 = 1·576104$	$\mu_3 = 1·584492$
$\mu'_1 = 1·569909$	$\mu'_2 = 1·577675$	$\mu'_3 = 1·586869$
$\mu''_1 = 1·497250$	$\mu''_2 = 1·502400$	$\mu''_3 = 1·508365$

* Amer. Journ. Sci. and Arts, xviii. p. 433.

If the curvatures corresponding to these rays be A, B, C, then—

$$A = \{(\mu_3 - \mu_2)(\mu'_2 - \mu'_1) - (\mu'_3 - \mu'_2)(\mu_2 - \mu_1)\}(\mu_2'' - 1)$$
$$= 0\cdot0000002549117$$

$$B = \{(\mu''_3 - \mu''_2)(\mu_2 - \mu_1) - (\mu_3 - \mu_2)(\mu''_2 - \mu''_1)\}(\mu'_2 - 1)$$
$$= 0\cdot0000007303256$$

$$C = \{(\mu'_3 - \mu'_2)(\mu''_2 - \mu''_1) - (\mu''_3 - \mu''_2)(\mu'_2 - \mu'_1)\}(\mu_2 - 1)$$
$$= 0\cdot0000005904547$$

$$F = 1$$

$$\frac{1}{f} = \frac{C}{A + B + C} = 5\cdot132568 \qquad \frac{1}{f'} = \frac{B}{A + B + C} = -6\cdot348405$$

$$\frac{1}{f''} = \frac{A}{A + B + C} = 2\cdot215837$$

$$\frac{1}{f} + \frac{1}{f'} + \frac{1}{f''} = 1 \qquad f' = -0\cdot157519$$

Corresponding curvature sum—

$$= \frac{\frac{1}{f'}}{\mu'_2 - 1} = -10\cdot989579$$

HARTMANN, J.—**Die Korrektur des potsdamer 80-cm. Objectivs.**
[The author describes how the constructional errors of this large lens were gradually reduced.]
Zeitschr. f. Instrumentenk., xxix. (1909) pp. 217–32 (1 pl. and 6 figs.).

(3) Illuminating and other Apparatus.

Arrangement for Microscopical Observations at Extreme Temperatures.*—H. E. Boeke describes the following apparatus intended for use with the ordinary polarising Microscope. It admits of observations and measurements in parallel and convergent polarised light, strong carbonic acid and ether, or liquid air being used as the cooling medium. The apparatus (fig. 120) consists of two cylindrical glass troughs G_1, G_2 of about 8·5 cm. diameter, set one above the other. Two thin-walled central glass tubes form the observation tube, and are made in one piece with the troughs. The height of the lower trough is 5 cm., and that of the upper 4 cm. These troughs serve for the reception of carbonic acid and ether or of liquid air. Quartz-glass for the troughs is to be preferred on account of its durability, in spite of its high cost. Both troughs are inclosed in a highly polished nickel casing, in two parts, so as to reflect off any external heating influences. The upper part of the nickel casing N_1 slips over the lower N_2, and contains a nickel floor *b b* with an asbestos layer, on which the upper cooling trough rests. A slide *s* of nickel plate is placed in this floor, and receives the preparation. A slit made in the upper nickel casing is large enough to admit

* Zeitschr. f. Instrumentenk., xxix. (1909) pp. 72–4 (1 fig.).

the ordinary plane-parallel mineral slab in a cork mount. A wooden handle *h* closes the slit. Two small holes are provided for the passage of thermo-elements intended for recording the temperature. The slit is also used for pouring through a special funnel the liquid air into the lower trough. Graduations of temperature were arranged by partly filling the lower trough. The upper trough is covered with a lid *d*, of nickel or of boxwood. The illuminating apparatus is placed in the lower central glass tube, and consists of a push-out collar with a plano-convex lens, and eventually with the condenser for convergent light. The observation tube is placed below, and is shut off by a vacuous double window *f*, this arrangement excluding trouble arising from ice or water condensation. Ordinary objectives do not suffice, because they are too short; a lengthening tube-piece is therefore required. Moreover,

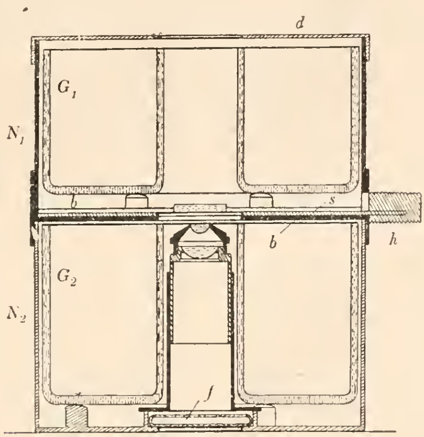

FIG. 120.

the microscope-stand is, in general, not sufficiently high to receive on the object-stage the cooling apparatus of some 10 cm. in height. A metal connecting-piece must therefore be fitted to the stand. The author tested his apparatus on gypsum, and used carbonic acid and ether as the first cooling agent. The interference colours of the gypsum plate instantly changed from red of the first order to the vivid blue of the second order. The effects with liquid air were still more marked. The author considers that his apparatus will also be of great use in examining the fluid deposits sometimes found in minerals.

Highly Reflecting Lantern Screens for Autochrome and other Projections.—A translation of a paper by H. Lehmann on the above subject has appeared in the Monthly Supplement to the British Journal of Photography.* Lehmann's paper was originally contributed to a German learned society, and appears in amplified form in recent issues

* Vol. iii. No. 30, June 1909, pp. 44–7 (4 figs.).

of Photographische Chronik. It deals with the preparation and use of screens of diffused metallic surface, whereby a greater degree of luminosity of projected picture is obtained. The higher the reflecting power of the screen the brighter will be the picture, and this consideration is of especial importance when the magnification is large, as it is in the case of cinematograph displays. Hence attempts have been made to produce screens with a metallic surface. Silvered glass has been used, but most successfully when the silvering has been applied to the matted instead of the polished face.

This silvering of the screen was the method employed by Lewis Wright in 1899, when he gave a display before our Society.* Instead of using silvered glass, however, Wright applied silver to a surface minutely ribbed or striated in a vertical direction, and the result was that not only persons sitting in front of the screen, but also those at the sides, could see. Wright also exhibited his screen before the Quekett Microscopical Club.†

Lehmann seems to have re-discovered Wright's process, but varies it by substituting aluminium for silver on a specially prepared and permanently rippled paper. He finds that, by suitable choice of the furrow or indentation on the screen, the distribution of the brightness may be regulated to a certain extent. It is best not to apply the aluminium as "paint," or, more strictly, as emulsion, but to apply a foundation of suitable viscosity and then to dust over with dry aluminium powder. The picture produced is extraordinarily bright, and reveals details of colour and structure which are quite unattainable on ordinary screens.

The same number of the Monthly Supplement ‡ notices an article on the same subject by Baron von Hübl, contributed to the Wiener Mitteilungen. The Baron discusses the angles within which persons in the auditorium would have the best view. Diagrams are given, and fully illustrate the necessary conditions.

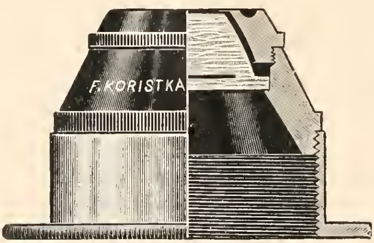

Fig. 121.

Koristka's Paraboloid Condenser.§—This condenser (fig. 121) is modelled on that of Siedentopf—the central part of the inferior surface is rendered opaque by means of a diaphragm, so that the emergent light is peripheral.

* See this Journal, 1899, pp. 247–8.
† Journ. Quekett Micr. Club, ser. 2, vii. (1898–1900) p. 241.
‡ Tom. cit., p. 47. § Koristka's Catalogue, xiii. (1908) p. 55, fig. 28.

Koristka's Projection Apparatus for Liquid.*—The disposition of the various parts of this apparatus are shown in fig. 122. The source of

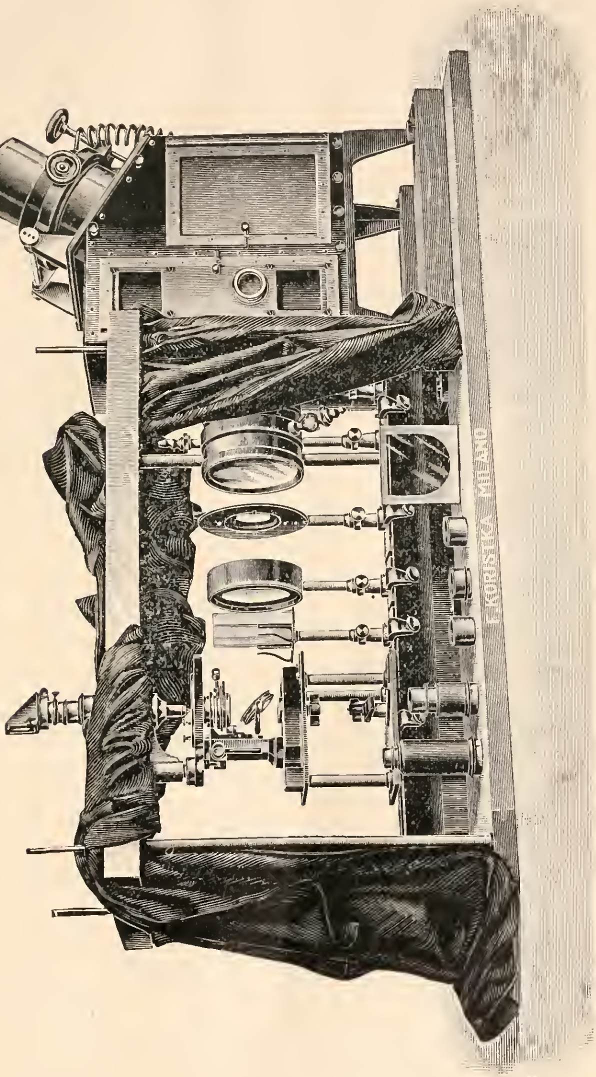

Fig. 122.

light is an electric arc lamp; the light passes through collecting lenses to the mirror up through the axis of the Microscope to a totally reflecting prism.

* Koristka's Catalogue, xiii. (1908) pp. 91–6, fig. 86.

(4) Photomicrography.

Elementary Photomicrography.*—W. Bagshaw's book, with the above title, has now reached its second edition. It is a work expressly intended for the beginner, and endeavours to encourage him instead of to dismay him. With this purpose in view, the author keeps strictly within suitable limits, and the beginner will, therefore, find exactly the help he requires. The instructions are all very clearly and unmistakably set forth, and no one attempting to follow them is likely to fail. The illustrations include examples of several beautiful objects.

(5) Microscopical Optics and Manipulation.

Microscopical Image Formation.†—Under the above title, F. J. Keeley discusses the present views on the theory of microscopic vision. He points out that there are two schools, the "diffraction" and the "dioptric." Although both of these have to deal with diffraction, the latter concerns itself only with such as arises within the instrument itself: the former attaches pre-eminent importance to diffraction originating in the object under examination. The author's aim is to study both theories in an unprejudiced manner supplemented by experiments, with the view of endeavouring to learn whether they are wholly irreconcilable. Up to the time of Abbe, the dioptric view had been unquestioned. This view, however, has had to give way to Abbe's theory, which has stood unrefuted up to the present time. But, recently, a feeling has been aroused that, without further modification, it fails to fully account for all features of observed microscopical images. Wright's "Principles of Microscopy," published in 1906, fully restates and expounds the old dioptric view, and performs its task so well that Keeley finds but one point open to criticism, viz., the employment of bright points and lines, as equivalent to self-luminous objects in explaining the formation of the diffraction patterns termed "anti-points." For the purpose of definitely testing the effects of aperture, he made a very careful series of observations with high-power objectives on two well-stained human blood corpuscles. Full details of the experiments are given by him, the N.A. varying from 1·20 to ·20. The variations in the results were well within the limits of experimental error, whence the author concludes that the unquestionable presence of "anti-point" phenomena need not be taken into consideration in connection with micrometry with white light, as a trained eye can select the same margins to measure under any ordinary conditions of illumination. This is not in the least contradictory to the theory, but demonstrates the possibility of overcoming a theoretical difficulty in actual practice.

In considering diffraction phenomena originating in the object, it will be well to first assume conditions under which the objective will be of greater aperture than the illuminating cone, and will, therefore, when examined with ocular removed, exhibit a disk of light, the dioptric beam, surrounded by an unilluminated space. The insertion of an object in the focus of the objective will result in this dark space showing

* Iliffe and Sons, London, 1909 (45 illustrations).
† Proc. Acad. Nat. Sci. Philadelphia, lxi. (1909) pp. 177–92.

more or less light which may be both refracted and diffracted by the object. If the latter has a fine structure, periodically arranged, this light reaching the outer zone of the objective's aperture will be mostly of diffraction origin, and will take the form of separated spectra. As the iris of the condenser is opened, however, it can be seen that the diffracted beams expand to the same extent as the dioptric beam, finally overlapping it and each other, until when the aperture of the objective is entirely filled with dioptric light it must unquestionably be similarly filled with diffracted rays. Unfortunately, there seems no way in which the beams derived from the two different sources can be completely separated, and the best expedient the author could devise to obtain some idea of the conditions present was to insert a semicircular diaphragm in the condenser, so oriented that the left side of the back of objective was completely filled with light up to its margin, the right-hand side receiving no direct rays whatever. Thus there would be full-cone conditions on one side, while the other would receive only refracted and diffracted rays; or, if certain suitable objects are employed, nothing but diffracted rays whose behaviour could be separately studied. For this purpose a binocular Microscope should be employed with a specially short-mounted objective, say a sixth of about ·80 N.A., the back lens of which will come close to the Wenham prism. All the direct light from the fully-illuminated left half of the objective will now pass up the right-hand tube of the Microscope, while the diffracted beams from the right-hand half of objective will be reflected up the left tube. Assuming that *Pleurosigma angulatum* is the object, and oriented longitudinally across the field in a right and left direction, on examination of the back of the objective, the previously dark space on the right will be found practically filled by three of the characteristic spectra of the object, and the other three will be present, although invisible, in the illuminated half. Thus, through the right-hand tube of the binocular, the image will be produced by a full dioptric beam supplemented by diffracted beams corresponding to those resulting from a small central illuminating cone; while through the left-hand tube it is derived from diffracted beams alone corresponding to those present with a full cone of illumination. On examination it will be found that both images are fairly well defined, but that the resolution of the fine structure is noticeably sharper and more distinct in the diffraction image through the left tube. The fact that the diffraction image is blue in colour is a proof that it is due practically exclusively to diffracted rays. Still further proof is, however, required to demonstrate that it is free from refracted rays. For this purpose the author inserts a narrow slit diaphragm in the condenser, thereby producing a sharp spectrum which can be magnified by a low-power objective inserted in the draw-tube. The Microscope can now be used as a spectroscope, and by allowing the light to pass through some colouring matter (e.g. eosin) which has well-marked absorption bands, these bands will be visible in the spectra at the back of the objective. It will be found that the absorption band in the spectrum derived from a diatom structure is perfectly black, thus furnishing a proof that it is practically free from refracted rays, for if it contained scattered refracted rays, as has been claimed, the absorption band would not appear black, but of the same colour as the light illuminating the object, which in this case is visually a bright red. If the previous diatom diffraction image be now examined under these new conditions it will be found that it is just as blue with this visually red light as it was with white light, owing to the fact that eosin transmits the blue rays freely; but the midrib of the diatom, and particularly any granular incrustation, such as may usually be found at places between the valve and cover-glass, will be tinted red, indicating that refracted rays or complete diffracted beams enter into their image formation.

The author considers that three important questions have now been settled: Firstly, that the diffracted beams from certain structures are free from refracted rays; secondly, that sharp, distinct images may result from such diffracted beams exclusively; thirdly, that, where such beams are sufficiently separated from the dioptric beam to permit of their being eclipsed by a suitable screen, no image of the elements producing them will be visible.

The author discusses several experiments described in Wright's "Principles of Microscopy," and points out their "fallacies," but for details of these criticisms reference must be made to his original paper.

The author's conclusions are adverse to the dioptric theory, and he reminds us that Abbe's knowledge of optics was so profound that he was liable to assume an equal knowledge on the part of his readers. If Abbe's later application of the diffraction theory to the images of coarser details, earlier termed "absorption images," could be interpreted as a denial that any refracted rays, outside the dioptric beam, entered into the image at all, then, indeed, some modification of what is generally understood as the Abbe theory is necessary, as most objects unquestionably refract light outside the dioptric beam; and not only do the simplest laws of refraction require that these rays find a place in the image, but there is no other way of accounting for what becomes of them. It is more likely, however, that Abbe regarded this fact as self-evident. At any rate, the important work he undertook was not to refute the dioptric theory, but to supplement it by accounting for phenomena which it then, as now, failed to explain.

Brownian Movement and Molecular Constants. — J. Perrin and Dabrowski * refer to the fact that molecular hypotheses anticipate that identical granules agitated by Brownian movement will behave as a function of the depth (as a perfect gas does under the action of gravity), and that they will satisfy the equation

$$\log \frac{n_0}{n} = \frac{N}{R\tau} v (\Delta - \delta) g h ;$$

where n_1 and n_0 are the concentrations of the granules in two layers at a distance h apart; v, the volume of the grain; $\Delta - \delta$, its apparent density (excess of true density over density of the fluid); N, Avogadro's constant (number of molecules contained in any molecule-granule). Experiments as to granules of gamboge have verified the above equation, and give for N the value $70 \cdot 5 \times 10^{22}$. At the same time,

* Comptes Rendus, cxlix. (1909) pp. 477–9.

M. Chaudesaigues working with the same granules, found that the following equation, also based on molecular hypotheses, was satisfied:

$$\xi^2 = \tau \frac{R\,T}{N} \frac{1}{3\,\pi\,a\,\zeta};$$

where ξ^2 is the square of the mean projection on an axis O_x of the displacement in a time τ of a granule of radius a as a fluid of viscosity ζ. In this case N works out to 70×10^{22}.

The authors have repeated these experiments with granules of mastic obtained by aqueous precipitation from the alcoholic solution of this resin. The apparent density of these granules is only one-third of that of gamboge, so that they formed a very suitable material for further verification of the formulæ. The layers measured were separated by intervals of $6\,\mu$. The granules were obtained after fractional centrifugation, and their radii were found to be $0 \cdot 52\,\mu$. Evaluation of the formulæ gave results confirming those of the previous experiments, and the average value for N was $70 \cdot 75 \times 10^{22}$. Hence it follows that the charge e of the electron is $4 \cdot 1 \times 10^{-10}$ electrostatic units.

J. Perrin * has also attempted to verify by experimental observation measurements the rotational equation given by Einstein,†

$$a^2 = \tau \frac{R\,T}{N} \frac{1}{4\,\pi\,\zeta\,a^3},$$

where ζ denotes the viscosity of the fluid, a the mean square of rotation of the granule in time τ about an arbitrary axis; R, T, N have the same meanings as above. The author had some difficulty in finding granules suitable for observation, but ultimately succeeded with a preparation of urea. The theoretical value of N is 65×10^{22}, and the experimental value (after many observations) found was $70 \cdot 5 \times 10^{22}$. The conclusion to be drawn is that the kinetic molecular hypothesis finds experimental corroboration in the study of Brownian movement.

(6) Miscellaneous.

History of Optical Glass.‡—M. von Rohr gives an interesting sketch of various personalities connected with the great Jena industry from about 1800 to the present time. The first names mentioned are those of P. L. Guinand and his son A. Guinand, who, with J. Fraunhofer, directed the manufacture till December 1813. A final separation seems to have then taken place, when J. Fraunhofer went to Benedictbeuren and the Guinands to France. G. Bontemps, who had gained his experience with the French house, entered the service of Chance Brothers, Birmingham, in 1848, and placed his knowledge of optical glass at the service of his employers. A kind of genealogical table is given showing clearly the connection of the various names with one another.

Practical Microscopy.§—The first edition of Shillington Scales' Microscopy was so much appreciated that only four years have elapsed

* Comptes Rendus., cxlix. (1909) pp. 549–51.
† Ann. der Physik, xix. (1906) p. 371.
‡ Zeitschr. f. Instrumentenk., xxix. (1909) pp. 50–7.
§ London: Baillère, Tindall, and Cox, 1909, xvi. and 324 pp. (122 figs.).

since it was first published as Elementary Microscopy. The second edition is called Practical Microscopy, an Introduction to Microscopical Methods. Much new matter has been incorporated, the scope of the book has been considerably enlarged, it has been nearly doubled in size, and much has been re-written, notably chapters iii. and vi., dealing with the choice of a Microscope, and with the practical optics of the Microscope. An entirely new chapter on Photomicrography has been added, and that on Microscopical Technique has been materially amplified.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Study of Tubercle bacilli.†—C. Siebert, from observations of two strains of tubercle bacillus, found that in glycerin broth the growth is associated with the production of acid; there is no difference in the acid formation of human tubercle and bovine tubercle. The amount of growth of tubercle bacilli in broth is greater if the acid formed is neutralised with soda, or if a piece of marble is added to the medium.

Dextrose and Lactose for Detecting the Colon Bacillus.‡—W. R. Stokes and H. W. Stoner consider that for the detection of the colon bacillus, dextrose, lactose, and saccharose broths should all be used, and that the organism should be plated out in pure culture. If one sugar must be used to identify sub-cultures, it should be lactose, and not dextrose, because there are many other types of organism that ferment dextrose exactly like *B. coli.* The authors consider that any organism producing 18–80 p.c. of gas in dextrose, lactose, and saccharose broths might be regarded as *B. coli* if it also showed the usual cultural characters.

Normal Cerebrospinal Fluid as Nutrient Medium for Pathogenic Bacteria.§—L. Vincenzi finds that *Diplococcus pneumoniæ*, *Gonococcus*, *Streptococcus erysipelatis*, and the bacilli of plague, diphtheria, and tubercle do not grow in normal cerebrospinal fluid. *Staphylococcus aureus* and anthrax grow badly, while *B. typhi*, *B. coli*, *B. paratyphi A* and *B*, *V. choleræ*, *B. dysentericus* Shiga, and *M. melitensis* grow fairly well but not luxuriantly.

Shaker (Kinotherm), for Use at a Desired Temperature.‖—P. Uhlenhuth has devised this apparatus (fig. 123) for shaking any substance such as bacterial extracts, etc., in a vessel. The motion is imparted

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, etc.; (6) Miscellaneous.

† Centralbl. Bakt., 1te Abt. Orig., li. (1909) p. 305.

‡ Tom. cit., p. 459. § Op cit., lii. (1909) pp. 154–6.

‖ Zeitschr. f. Immunität. forsch. u. exper. Therapie, ii. (1909) No. 3, through Centralbl. Bakt., 1te Abt. Ref., xliv. (1909) pp. 629–31 (1 fig.).

through the band B, driven by a water-motor, A, to the wheel C. The rotary movement is converted into a swinging one through the rods E, G, J. To J can be fixed, by means of a clamp, any vessel, such as an Erlenmeyer's flask; this swings in a water bath, L; the level of the water is so arranged that about one third of the vessel is immersed. The water is kept at the desired temperature by means of a gas thermo-

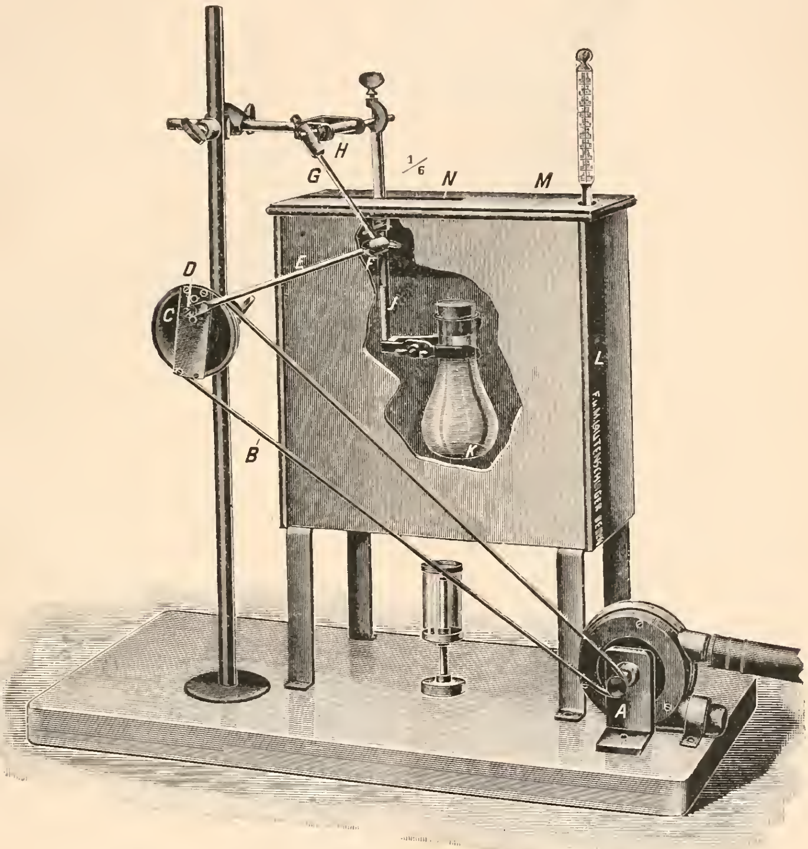

Fig. 123.

regulator. The number of oscillations is given by the turns of the motor, and these can be regulated within certain limits.

Different kinds of oscillation may be imparted by setting the rod E in different holes at D, and these movements may be further graduated through the intermediary of the block F, to which the rods E, G, J are connected directly, and with the wheel C and the piece H indirectly.

Altmann's Shakers.*—In the accompanying illustration are given two varieties of shaker made by Altmann. One is worked by a water turbine (fig. 124), the other is driven by electricity (fig. 125).

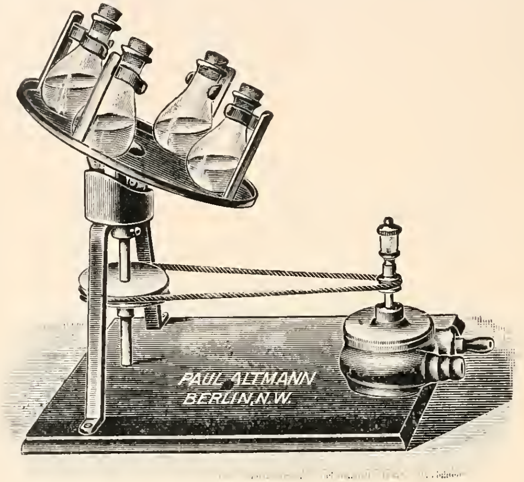

Fig. 124.

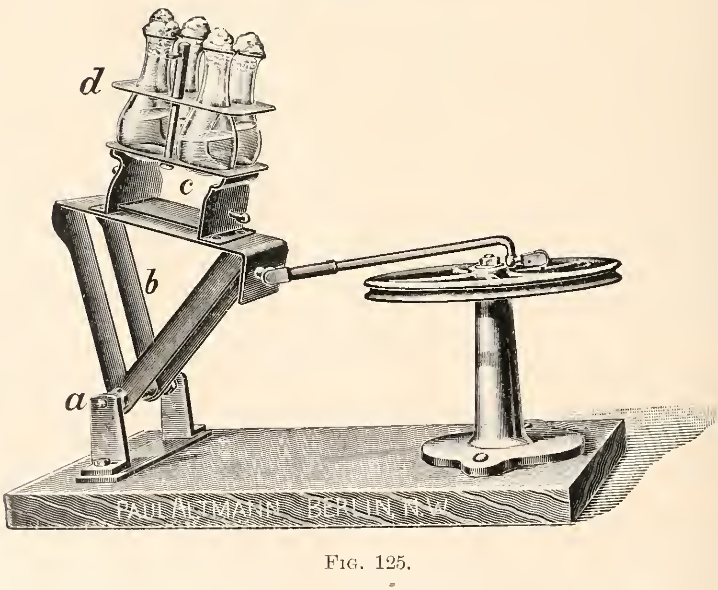

Fig. 125.

Buckingham, Edith, N.—**Light-weight Portable Outfit for the Study and Transportation of Ants.** *Amer. Nat.*, xliii. (1909) pp. 611–14 (2 figs.).

* Paul Altmann's Special Catalogue, 1909.

(3) Cutting, including Imbedding and Microtomes.

Theory and Practice of Whetting.*—L. W. Ssobelew discusses this important subject at considerable length, with especial reference to microtome and surgical blades. The former is naturally of most interest to microscopists, but both classes of blades involve the principles of wedge and saw. Most knives have a wedge-shape and numerous tiny teeth on the edge. A knife, when used, is not only pushed deep into the tissue, but also acts as a saw. The best treatment of a tissue is attained by making the wedge as thin and as sharp as possible; the saw being as slender, and its teeth as small, as possible. In whetting a knife the inclination of the blade is of the first importance. The proper angle of inclination may be attained freehand by an expert: but a safer method is to fasten the blade in a little tube-shaped frame slit longitudinally for the reception of the back of the blade. The blade in its frame is then placed on the hone, the edge forwards, and is drawn towards the operator, the movement commencing at the heel (i.e. the part nearest the handle) and finishing at the knife-point. A blade with a curved edge will also require a correspondingly curved stroke. The knife should then be reversed and the other side similarly treated. Pressure is scarcely needed, the weight of the knife should suffice. Pressure is apt to favour a "furred" edge, which, however, is unimportant beyond the useful edge of the instrument. The best way of testing an edge is by the thumb. For this purpose the knife-handle is held in one hand and its back rests on the four fingers of the second hand, the thumb of which gently feels from above the keenness of the edge. This co-ordination of the two hands secures great delicacy of touch and a clear perception of the character of the edge—whether it is sharp, or turned, or bowed—and, finally, whether a coarse-grained or a fine-grained stone should be used. With practice, it may even be judged whether the knife can cut sections 5 μ or 10 μ thick. The critical sensation is obtained at the moment of lifting off the thumb, and therefore only short distances, 2 or 3 cm. at a time, should be tested. The author, in the application of this test, has never cut himself deeply enough to draw blood. For surgical knives such a mode of testing would be unsuitable, as the existence of any slight wound might be a source of danger. The author therefore recommends that such a knife held at a sharp angle should be pressed on the hair at the back of the operator's head. If it cuts the hair freely, it is ready for stropping. Among materials suitable for hones he finds that:—

1. Natural red Russian sandstone, moistened with water, soon gives an edge, although somewhat of a coarse one.

2. Grey natural whetstones, moistened with water or oil, act somewhat slowly, but give a very fine edge.

3. Yellow Belgian whetstones (said to be artificial, but not always homogeneous), moistened with oil, give a fine edge very suitable for microtome knives.

4. White American natural whetstones, called Arkansas or Mississippi stones, are slow, but give a very good edge; especially suitable in cases where stropping is impossible, e.g. with dentists' and oculists' instruments.

A whetstone should always be moistened with a suitable fluid (e.g.

* Zeitschr. wiss. Mikrosk., xxvi. (1909) pp. 65–79 (7 figs.).

ordinary water, soapy water, petroleum, olive oil), and the knife should be wiped with a clean linen cloth.

A fine-grained, smooth strop should be selected, and its under side should be used. The under side is at first covered with connecting tissue, but this has to be carefully rubbed away with emery paper so as to expose

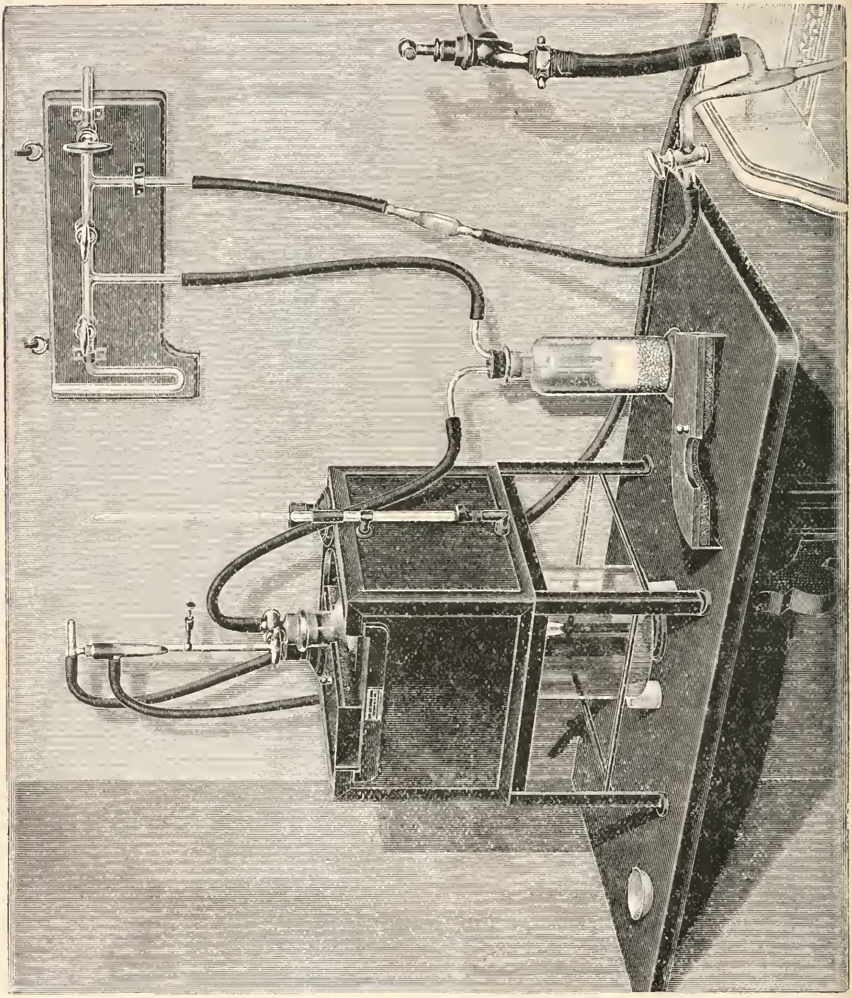

Fig. 106.

the corium. The strop, set on a pad of yielding felt, is then mounted on a board and is ready for use. The knife is placed as in whetting, but is urged forwards. A knife may be preserved from possible oxidation by imbedding it in paraffin or fat. Some blades may be wrapped up in wadding.

Vacuum Paraffin Oven.*—L. Materna describes a paraffin stove (fig. 126) for imbedding, the principal feature being a thermostat, the copper jacket of which is filled with distilled water. The outside of the thermostat is covered with linoleum, and the apparatus is fitted with

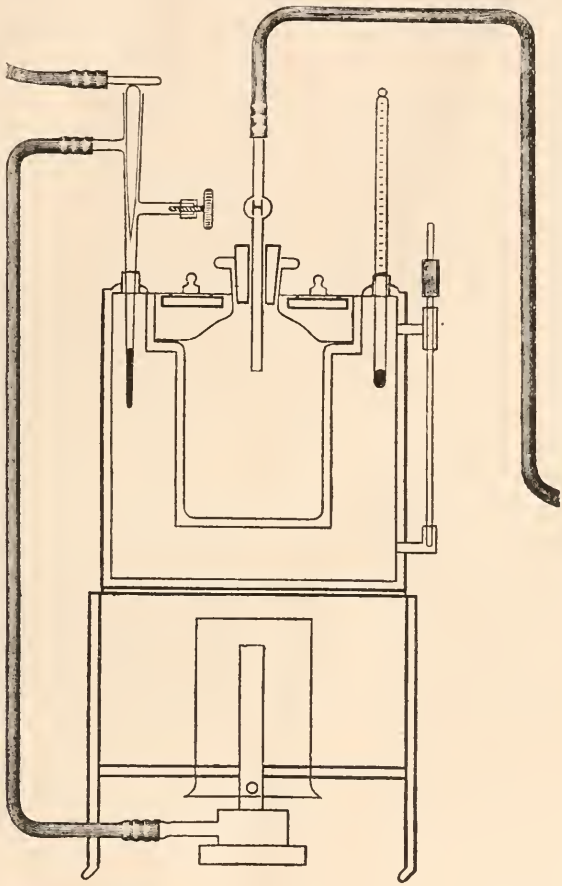

Fig. 127.

the usual thermometer and thermo-regulator, and is heated by means of a Bunsen burner. Inside the thermostat is a strong glass jar (fig. 127) connected by tubes with a water-pump. Between the water-pump and the thermostat are inserted a manometer for indicating the pressure, and a wash-

* Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 439–45 (2 figs.).

bottle to prevent any dirt from interfering with the manometer. The top of the thermostat is covered with a double lid which is divided into two halves, each of which is surmounted by a knob for facilitating removal. The object of this double lid is to keep as much heat in as possible: one half is shown separately lying on the base board of the thermostat (fig. 126). The temperature of the water in the jacket should range from 62–65° for a paraffin mixture with a melting point of about 55°. For the preliminary saturation the author uses water-free aceton chloroform or xylol. To start the apparatus the taps of the exsiccator and of the water-pump are turned on, and after about half an hour the water-pump tap is turned off. The tap of the manometer is then carefully and slowly opened until the mercury in the closed limb has risen. As soon as the atmospheric pressure is restored the exsiccator may be opened.

Transparent Red Injection Mass.*—R. Krause uses a tin trough 28 × 15 × 10 cm. A sieve-tray rests inside, supported by the handles; the measurements are 1 to 2 cm. less than those of the trough. The lid has pieces cut out to slip over the handles. The gelatin is placed in the tray, and macerated in water for about 2 hours; the sieve is then lifted out, and the water allowed to drain off for $\frac{1}{4}$ to $\frac{1}{2}$ hour. It is then stained with borax-carmine. 100 grm. of borax are dissolved in 2 litres of hot water, and 15 grm. of powdered carmine added, after which the mixture is boiled. Next day the superuatant fluid is poured off into the trough; the tray with the gelatin is then replaced in the trough. In 48–72 hours the tray is removed, the gelatin allowed to drain, and then washed several times in the trough with fresh water. The colour is fixed by means of 2 p.c. hydrochloric acid, of which 5–10 litres are necessary. The gelatin plates, 5 or 6 at a time, are removed from the sieve and immersed in the acid until they become of a cherry red colour. After this they are replaced in the tray, and the trough filled with water kept running in order to remove any excess of acid ($\frac{1}{2}$ to 1 hour). The gelatin thus prepared may be preserved for future use by means of camphor. The mass does not diffuse through the walls of the injected vessels; it is always transparent, and the carmine never precipitates.

HICKLING, G.—**The Microscopic Study of Rocks.**
[The author deplores the fact that microscopists pay little attention to the study of rocks: simple directions are given for making slides of rocks.] *Trans. Manchester Micr. Soc.* 1908, pp. 64–70.

(4) Staining and Injecting.

Double-staining Vegetable Tissue.†—A. E. López first treats the sections with eau de javelle or with an aqueous solution of chloral-hydrate. After repeated washings the sections are placed in a concentrated solution of caustic potash for 10 minutes. They are again washed, and then stained in a mixture of Delafield's hæmatoxylin and 1 p.c. iodine green for 10 minutes. The hæmatoxylin and iodine green

* Zeitschr. wiss. Mikrosk., xxvi. (1909) pp. 1–4 (1 fig.).
† Bol. R. Soc. Española Hist. Nat., ix. (1909) pp. 237–8.

solutions are mixed in the proportion of 10 to 1 : after a good shaking the solution is ready for use. On removal from the stain the sections are washed in water and mounted in glycerin, glycerin jelly, or balsam.

Modification of Nissl's Method.*—Rodenwaldt describes a simplified Nissl method and its application to Beriberi. A solution of Azur ii. in the proportion of 1 grm. to 750 c.cm. of distilled water is made, and to 10 c.cm. of this solution 4 drops of a saturated solution of potassium-carbonate are added immediately before use.

Van Gieson and Romanowsky Stains for Detection of Coccidia.†
P. B. Hadley recommends Van Gieson's stain for rapidly detecting coccidia in the intestines or cæca. It is made as follows : To 10 c.cm. of distilled water add 2 drops of saturated 95 p.c. alcoholic solution of rose-anilin-violet and 10 drops of a 50 p.c. solution of methylen-blue. The smears, made in the usual way, are fixed in alcohol. The stain is heated to vaporisation, and then the slide is washed in water, mopped up with blotting paper and dried in air.

The Romanowsky stain was used for demonstrating the finer nuclear structure of different stages of *Coccidium cuniculi.*

Demonstrating the Intracellular Network of Nerve-cells.‡—F. Marcora places the pieces for 7 to 8 hours in a mixture consisting of arsenious acid 0·75 p.c., 40 parts ; formol, 10 parts. After this they are immersed for 12 hours in 2 p.c. silver nitrate solution. The developer consists of hydrochinon 20, sodium sulphite 5, formol 50, distilled water 1000. After this the pieces are cleared up and imbedded in paraffin. The sections, which should be 10–15 μ thick, are then passed through downgraded alcohols to water, and afterwards treated with the following mixture, which is composed of two solutions. Solution A contains sodium hyposulphite 30, ammonium rhodanate 30, distilled water 1000. Solution B : gold chloride 1, distilled water 100. The sections are next washed in distilled water and then bleached by the following method. For 5 to 10 minutes the sections are immersed in the following mixture : potassium permanganate 0·5, sulphuric acid 1, distilled water 1000 ; and then passed rapidly through a 1 p.c. solution of oxalic acid, after which they are frequently washed in distilled water. This is followed by Nissl's procedure, viz. staining with an aqueous solution of magenta-red warmed to vaporisation ; then 95 p.c. alcohol and differentiating in oil of cloves. Dehydration ; xylol ; balsam. By this method not only is the intracellular network well shown, but it also demonstrates that Nissl's bodies lie in the interspaces of the network.

Staining Treponema pallidum.§—F. L. de Verteuil fixed smears in absolute alcohol and then stained them with 10 p.c. silver nitrate for an hour at about 100° F. and afterwards reduced with 5 p.c. pyrogallic acid for 10 minutes.

* Monats-schrift. f. Psych. u. Neurol, April 1908. See also Zeitschr. wiss. Mikrosk., xxv. (1909) pp. 332.

† Centralbl. Bakt., 1te Abt. Orig., lii. (1909) pp. 147–50.

‡ Anat. Anzeig., xxxv. (1909) pp. 65–9 (1 fig.).

§ Lancet, 1909, ii. pp. 884–5.

Absence of Altmann's Granules in Cancer Cells.*— H. Beckton adopted the following procedure in an investigation as to the absence of Altmann's granules from cells of malignant new growths :—1. Take small pieces of tissue as soon as possible after an operation. 2. Place in formol-Müller (1 in 49) at room temperature for a week, renewing the solution on the second and fourth days, and then in Müller's fluid for another week. Usually for very small pieces, 1 mm. thick, 3 days are sufficient. 3. Wash overnight in running water ; a few hours is sufficient time for very small pieces. 4. Alcohol in increasing concentration ; cedar-wood oil or xylol ; paraffin, 75° C. 5. Cut sections not thicker than 5μ and mount on slides. 6. Xylol ; absolute alcohol ; rinse in water. 7. Stain in anilin-acid-fuchsin. 8. Differentiate with picric-acid alcohol or with aqueous solution of sodium bicarbonate (1 in 10,000). 9. Absolute alcohol ; xylol ; Canada balsam.

The stain is prepared thus :—To 100 c.c. of filtered cold saturated watery solution of anilin add 20 grams of acid-fuchsin ; shake well and filter. The picric acid alcohol is made by adding 7 volumes of 20 p.c. alcohol to 1 volume of saturated picric acid solution in absolute alcohol.

The process of staining may be carried out at room temperature, the slide being placed vertically in the staining fluid for, say, half-an-hour. This method is free from any objection which may be urged against the use of a hot staining fluid. The following method, however, gives the same results and is most expeditious and convenient. Cover the section with staining fluid, and this in turn with a watch-glass, and heat for 2 minutes to about 60° C., using either a thermostat or a strip of copper heated at one end and tested from point to point by means of a piece of paraffin wax. Next pour off the stain, blot, and differentiate ; a point is soon reached at which but little further colour comes away. As a rule, at ordinary temperatures differentiation is complete with picric-acid alcohol in about 2 minutes, and with sodium bicarbonate in about ½ minute.

It may be noted here that absolute alcohol does not decolorise a section, but dilute alcohol discharges the colour rapidly, while plain water removes it but slowly, and indeed differentiates sufficiently to enable one to detect the presence of granules. Again, while in moderately dilute mineral acids the colour remains in a section for a long period, moderately dilute alkalis rapidly discharge it, and very dilute alkalis may be used as differentiating fluids.

After fixation with formalin alone, as well as after formol-Müller solution, granules can be demonstrated in the essential cells of pancreas, submaxillary gland, liver, kidney, columnar epithelium of the alimentary tract, etc. ; but this is not the case with lymphocytes, plasma cells, endothelial cells, fibroblasts, fat-cells, etc., which show granules only after fixation with formol-Müller. It thus appears that the granules by this method may be appropriately referred to as belonging to a "gland cell group" and a "connective-tissue cell group" respectively.

The conclusion drawn from the results of this investigation is, that in malignant new growths granules tend to disappear, or to be absent altogether, from the particular type of cell involved.

* Brit. Med. Journ., 1909, ii. pp. 859–61 (3 figs.).

(5) Mounting, including Slides, Preservative Fluids, etc.

NEWTON, A.—**Preparing Insects and Parts for Mounting in Balsam.**
Trans. Manchester Micr. Soc., 1909, pp. 79–80.

H. M. C.—**Mounting Slides.**
English Mechanic, xc. (1909) pp. 165, 189–90, 212

(6) Miscellaneous.

Micrometer Attachment.*—S. A. McDonald describes the following modification of the ordinary micrometer. A piece of brass tubing (fig. 128) is reamed out to make a sliding fit on the anvil of the micrometer. The

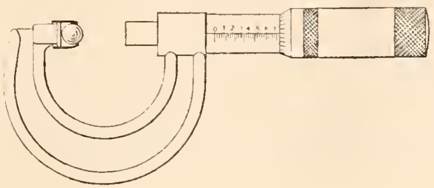

FIG. 128.

tubing holds loosely a $\frac{1}{4}$ in. bicycle ball, which extends beyond the end of the tube, the latter being bent over to prevent the ball from falling out. The reading is taken from the 0·250 in. graduation as zero.

Metallography, etc.

Meteoric Iron.†—W. Fraenkel and G. Tammann have studied two pieces of meteorite containing respectively 7·8 and 9 p.c. nickel. Sections were examined, after heating to different temperatures under conditions which almost entirely prevented oxidation. The temperatures of magnetic transformation were also determined. Attempts were made to reproduce artificially the structure of meteorites, but without positive results. Long heating of meteoric iron at 420° C. causes the kamacite to granulate ; it would therefore appear that meteoric nickel-iron alloys are unstable at the ordinary temperature. The constitution of meteorites and the causes of the structural differences between meteorites and alloys of the same composition prepared by melting the metals together, are fully discussed. Possibly, as in the case of chromium and molybdenum steels, changes take place in the molten state dependent on the maximum temperature attained, and the characteristic constitution of nickel-iron meteorites may be due to the attainment of an exceedingly high temperature at some period in their history.

Structure of "Steely" Cast Irons.‡—J. Guillemin has examined microscopically four cast irons containing 2·65–2·95 p.c. graphite,

* "Machinery," see English Mechanic, xc. (1909) p. 178.
† Zeitschr. Anorg. Chem., lx. (1908) pp. 416–35 (27 figs.).
‡ Rev. Métallurgie, vi. (1909) pp. 946–50 (12 figs.).

0·50–0·65 p.c. combined carbon, 0·57–0·64 p.c. manganese, 0·30–0·42 p.c. phosphorus, 0·08–0·10 p.c. sulphur, 1·30–1·51 p.c. silicon. Photomicrographs were taken of specimens (1) as cast; (2) annealed for 1 hour at 600°, 700°, 800°, 900°, and 1000° C.; (3) quenched in water after 5 minutes heating at 700°, 800°, 900°, and 1000° C.; (4) quenched after 1 hour heating at temperatures as in (3): (5) reheated for 1 hour at 400° C. after above quenchings. Kourbatoff's reagent, nitric acid and orthotrinitrophenol in ethyl-alcohol, was used for etching. Austenite was observed in some specimens quenched at 1000° C. The mechanical properties of these cast irons may be improved either by annealing at 900° C., or by a quenching from 900° C. followed by reheating.

Separation of Graphite in Cast Iron.*—G. Charpy has heated powdered white cast iron at temperatures 600°–1200° C. under pressures up to 15,000 atmospheres. The iron was placed in a hollow magnesia-lined steel cylinder, and the pressure applied through pistons, one at each end, through which the electric current for heating the sample passed. In all cases graphite resulted from the decomposition of carbide of iron, at temperatures 700°–1100° C.

Solubility of Steel.†—E. Heyn and O. Bauer have further extended the application of their method of investigating the constitution and condition of steel by determining its rate of solution in 1 p.c. sulphuric acid.† The influence of the treatment of steel on its solubility in sulphuric acid is here dealt with. The effect of quenching and subsequently reheating to different temperatures was studied with steels containing 0·95 and 0·07 p.c. carbon. The influence of cold working and annealing was determined with steels containing 0·05, 0·06, 0·08, and 0·19 p.c. carbon. Many of the authors' conclusions have been given previously.‡ Differential heating curves of steel containing 0·95 p.c. carbon, quenched from 900° C., indicate that the bulk of the heat produced by the decomposition of the martensite is evolved below 400° C. This points to the segregation of one or more solid bodies, x, the nature of which is doubtful, from the solid solution martensite during tempering up to 400° C. Whether the segregation proceeds ultra-microscopically or microscopically is an open question. For some chromium-tungsten steels examined, there appears to be a direct connection between quenching temperature and solubility in sulphuric acid. The solubility of mild steel in sulphuric acid is increased by cold work, and falls again when the cold worked steel is reheated. Very small amounts of permanent distortion in structural steel can be detected by solubility tests.

In the correspondence on this paper, C. Benedicks replies to certain objections raised by the authors to the view that troostite is a colloidal solution, or, to use a preferable term, a colloidal system. H. M. Howe sums up the evidence for each of the rival theories of the constitution of troostite, the colloid theory and the osmondite theory. Neither theory yet appears to be established or disproved.

* Rev. Métallurgie, vi. (1909) pp. 983–5 (1 fig.)
† Journ. Iron. and Steel Inst., lxxix. (1909) pp. 109–241 (53 figs.).
‡ See this Journal, 1907, pp. 115–16. ‡ Loc. cit

Heat-treatment of Steel.*—A. McWilliam and E. J. Barnes have carried out tensile tests, and Arnold alternating stress tests on nine acid Bessemer steels, heat-treated in various ways. The carbon content of the steels varied from 0·10–0·86 p.c.; the samples were treated in the form of 1 in. round bar. The steels were tested (1) as received; (2) air-cooled from 950° C.; (3) slowly cooled after 35 hours at 950° C.; (4) quenched in water from 850°, 900°, or 950° C., and tempered at 400°, 500°, 600°, or 700° C. The very slow cooling of treatment (3) caused the cementite of the pearlite to coalesce into globules; no pearlite remained in the 0·10 p.c. carbon steel after this treatment. No difference in micro-structure was observed between the steels tempered at 500° C., and those tempered at 700° C. A Bessemer steel, with 1 p.c. manganese, consisting entirely of pearlite, contains about 0·80 p.c. carbon.

Ageing of Mild Steel.†—C. E. Stromeyer has further investigated this subject,‡ and finds that brittleness in mild steel is frequently due to excessive percentages of phosphorus and nitrogen, the latter element being particularly dangerous.

High-tension Steels.§—P. Longmuir gives the results of a large number of tensile and other tests of nickel steels, nickel-chromium steels and chromium-vanadium steels, heat-treated in various ways, and concludes that nickel steels are inferior to either of the two other classes, chromium-vanadium steels giving especially high values.

Uniform Nomenclature of Iron and Steel.‖—H. M. Howe and A. Sauveur present the second report of the committee appointed to consider this subject. The report includes definitions of the microscopical constituents of iron and steel. "Metaral" is suggested as the equivalent of "microscopical constituent." Austenite is a solid solution of carbon, or carbide of iron, in γ-iron, stable above the critical range. The authors adhere to the transformation scheme, austenite-martensite-troostite-sorbite-pearlite.

Binary Alloys.¶—K. Bornemann reviews all the published work on the constitution of binary alloys of metals, and gives a large number of equilibrium diagrams. From a critical comparison of the results obtained by different workers on the copper-zinc system, the author concludes that the compound Cu_2Zn_3, melting without decomposition, undoubtedly exists. Another compound, more rich in copper, possibly has the formula CuZn, and decomposes, more rapidly at higher temperatures, into copper and Cu_2Zn_3. The copper-aluminium and copper-tin systems are discussed at some length. These papers collect, in useful form, a large quantity of scattered data.

* Journ. Iron and Steel Inst., lxxix. (1909) pp. 348–82 (12 figs.).
† Tom. cit., pp. 404–25 (2 figs.).
‡ See this Journal, 1907 p. 640.
§ Journ. Iron and Steel Inst., lxxix. (1909) pp. 383–403 (1 fig.).
‖ Proc. Int. Assoc. for Testing Materials, No. 10 (1909) 18 pp.
¶ Metallurgie, vi. (1909) pp. 236–53, 296–304, 326–36, 490–500 (93 figs.).

Binary Systems.—J. J. van Laar* develops mathematically the theory of the form of the melting-point or solidification-point curves of binary systems when the solid phase is an amorphous solid solution, or mixed crystals, of the two components. In a later paper† the author deals with the cases in which a compound occurs.

Hardness of Metallic Solid Solutions and Chemical Compounds. N. S. Kurnakow and S. F. Zemczuzny‡ collate the results obtained by themselves and others relating to the hardness of binary alloys. When the metals form a continuous series of solid solutions, the curve showing relation of hardness to composition is continuous and passes through a maximum, this maximum corresponding to the minimum of electrical conductivity. The occurrence of a chemical compound, which may be harder or softer than the two metals, causes a break in the curve. If the alloys are mechanical mixtures of the two metals, the curve is a straight line. The hardness curve of more complex binary systems is a combination of the above types.

C. Benedicks§ discusses the above paper, and points out that the character of the curves connecting electrical properties with composition indicates that, while in the case of metallic aggregates conductivity is a suitable criterion of composition, resistance is more suitable for solid solutions.

Formation of Alloys by Pressure.‖—G. Masing has submitted mixtures of finely divided metals to pressures of 1000–5000 atmospheres, to ascertain if alloys similar to those obtained by melting could thus be produced. The numerous binary mixtures pressed are classified according to their behaviour upon solidification from the corresponding binary melts:—(1) the two metals solidify as pure components; (2) compounds are formed, but no solid solutions; (3) a continuous series of solid solutions is formed; (4) interrupted series of solid solutions are formed. The block obtained by pressing was examined microscopically, and heating curves were taken. The author concludes that the mass obtained by compressing file-dust of two metals together consists exclusively of grains of the two metals; in no case could the presence of solid solutions or compounds be established. Thus pressure does not induce the formation of compounds or solid solutions. The only possible influence of pressure is to bring about more intimate contact between the metals. Pressed mixtures differ essentially in structure and properties from alloys obtained by melting whenever those alloys contain solid solutions or compounds. If, however, two metals can form a compound, noticeable amounts of the compound may be formed in the solid state. If solid solutions occur in the system, diffusion may take place in the solid state at ordinary temperatures, and more rapidly at higher temperatures. The heating curve of a pressed block differs from that of the alloy obtained by melting, and accordingly cannot be reproduced by a second heating of the same mass.

* Zeitschr. Phys. Chem., lxiii. (1908) pp. 216–53; lxiv. (1908) pp. 257–97 (53 figs.).
† Op. cit., lxvi. (1909) pp. 197–237 (14 figs.).
‡ Zeitschr. Anorg. Chem., lx. (1908) pp. 1–37 (12 figs.).
§ Op. cit., lxi. (1909) pp. 181–6 (1 fig.).
‖ Zeitschr. Anorg. Chem., lxii. (1909) pp. 265–309 (43 figs.).

Some Silver Alloys.*—E. Pannain finds that copper may with advantage partially be replaced by nickel or cobalt in silver coins. Methods of preparation and the properties of the alloys obtained are given.

Some Chromium and Manganese Alloys.†—G. Hindrichs has studied the binary alloys of chromium with tin, lead, copper, silver and aluminium, and of manganese with aluminium and silver, by thermal and microscopical methods. As chromium at its melting point, 1550° C., is viscous, it was necessary to exceed this temperature considerably to obtain homogeneous alloys. Owing to the great experimental difficulties, the results are somewhat uncertain. The metals of each binary system were found to be only partially miscible in the liquid and less so in the solid state. The existence of the only compounds indicated, $AlCr_3$, Al_3Mn, and $AlMn_3$, is doubtful. Tammann's rule that in a binary system A B, A being the metal with the lower melting point, the solid solubility of A in B is greater than that of B in A, is confirmed. It is assumed that when the melting point of A is not appreciably lowered by the addition of the more difficultly fusible metal B, B is insoluble in A at that temperature.

Electrical Conductivity of Magnesium-lead Alloys.‡ — N. J. Stepanow has worked out a method for the determination of the conductivity of brittle and easily oxidised alloys. Magnesium and lead were melted together in a graphite crucible under a layer of fused salts. The alloy was drawn up into a previously heated hard glass tube lined with soot. After cooling the tube was broken away. Rods, several cm. long and 3–4 mm. diameter were thus obtained; their conductivity was measured at 25° and 100° C. The concentration-conductivity curve agrees generally with the equilibrium diagram obtained by thermal and microscopical methods. The existence of a solid solution, containing up to 4 atomic p.c. lead, not detected by thermal or microscopical methods, is indicated by the more sensitive electrical conductivity method. The general relation between constitution and electrical conductivity of alloys is discussed.

Compounds of Nickel and Phosphorus.§—N. Konstantinow has determined the equilibrium diagram by thermal methods and examined the alloys microscopically. The compounds Ni_3P, Ni_5P_2, Ni_2P, and one still more rich in phosphorus, were found. Ni_5P_2 exists in two modifications, α and β.

Lead-palladium Alloys.‖—N. A. Puschin and N. P. Paschsky have determined the electric potential of a number of alloys of lead with palladium, against pure lead in a solution of lead nitrate. The form of the potential curve indicates the existence of the compound Pb_2Pd.

* Gaz. chim. ital., xxxviii. (1908) pp. 349–51, through Journ. Soc. Chem. Ind. xxvii. (1908) p. 813.
† Zeitschr. Anorg. Chem., lix. (1908) pp. 414–49 (7 figs.).
‡ Op. cit., lx. (1908) pp. 209–29 (3 figs.).
§ Tom. cit., pp. 405–15 (11 figs.).
‖ Op. cit., lxii. (1909) pp. 360–3 (1 fig.).

Gold-magnesium Alloys.*—R. Vogel has determined the equilibrium diagram by the method of thermal analysis, and confirmed it by microscopic examination of alloys. The system is compared with the gold-cadmium and gold-zinc systems. Three maxima indicate the occurrence of the compounds $AuMg$, $AuMg_2$, $AuMg_3$. Three series of solid solutions occur.

Tin-lead Alloys.†—P. N. Degens has redetermined the equilibrium diagram. The quantity of alloy used for cooling curves was about 160 grams, and the cooling from 300–100° C. occupied 25–35 minutes. The freezing point curve indicates complete miscibility in the liquid state, the formation of a eutectic freezing at 181° C. and containing 24·4 atomic p.c. lead, a solid solubility of tin in lead of 12 atomic p.c., a very small solid solubility of lead in tin, and gives no evidence of the formation of compounds. In alloys containing 0–88 p.c. lead a thermal critical point was found at 146° C., and the occurrence of a change at this temperature was confirmed by dilatometric measurements. The author holds that a compound separates at 146° C. Lead-rich alloys were etched with a 5 p.c. solution of acetic acid in ethyl-alcohol.

Sub-oxides of Caesium.‡—The solubility of metallic oxides in the molten metals has some important practical bearings in metallurgy. For the study of this phenomenon Rengade has selected caesium because of its low melting point and its capacity for holding in solution a large amount of oxide. The caesium-oxygen system was studied by the method of thermal analysis. The equilibrium diagram given was derived from data yielded by heating curves in preference to cooling curves, as the supercooling observed in the solidification of the melts rendered the indications of cooling curves uncertain. The operations were carried out in vacuo or in an atmosphere of nitrogen. Starting with the pure metal, melts of increasing concentration in oxygen were obtained by admitting, successively, known quantities of oxygen to the glass tube containing the caesium. The compounds found were Cs_7O, Cs_4O, Cs_7O_2, Cs_3O, Cs_2O. Three eutectic points were observed, one belonging to a labile equilibrium. No solid solutions occur. Some microscopic observations were made.

Physico-chemical Studies in Tin.§—E. Cohen has studied the occurrence of "tin-pest" in old coins, and ascribes it to the change from the usual form of tin to the brittle-grey variety, taking place below 18° C.

Basic Bessemerising of Copper-matte.‖—F. Schreyer, in the course of investigations on this subject, has made a metallographic study of the system $FeO - Fe_2O_3$ with indefinite results. Sections cut from fused mixtures of the oxides, in different proportions, were polished and etched

* Zeitschr. Anorg. Chem., lxiii. (1909) pp. 169–83 (13 figs.).
† Tom. cit., pp. 207–24 (18 figs.).
‡ Rev. Métallurgie, vi. (1909) pp. 934–45 (5 figs.).
§ Zeitschr. Phys. Chem., lxiii. (1908) pp. 625–34 (15 figs.).
‖ Metallurgie, vi. (1909) pp. 190–7 (22 figs.).

with concentrated nitric acid. Attempts to colour the different oxides by the action of ferro- and ferri-cyanide of potassium were unsuccessful.

Mounting of Specimens.*—R. Baumann describes some useful contrivances, which do not appear to be generally known, for mounting polished sections. Small objects may be placed within a turned metal ring on a level surface, with the polished surface down, and a slide on which is a piece of modelling-wax, pressed down on the specimen. Two pairs of rings, diameter 25 and 50 mm., height 15 and 25 mm., used singly or in combination, give six variations of the arrangement for objects of different size. Mounted in this way, the specimen may be held by means of the stage clamps on the stage of a horizontal Microscope. R. Winkel's apparatus for marking a particular field is useful. Screwed into the tube in place of the objective, it scratches a circle on the polished section by means of a diamond point. Specimens too heavy for observation with a horizontal Microscope when mounted as above, may be mounted in a similar way, but with the polished surface at right angles to the slide, and are then supported on a supplementary stage projecting (horizontally) at right angles from the ordinary stage. For large and heavy objects the Microscope must be so constructed that it can be placed on the object. The Zeiss I C stand permits of the replacement of the foot and substage by a foot-plate, through an opening in which the specimen is observed. For photography, a reflecting prism is fixed above the eye-piece.

Magnetic Properties in relation to Mechanical Tests.†—A. Grünhut and J. Wahn report on von Hoor's proposal to utilise the magnetic and electric properties of materials to determine the mechanical properties. Magnetism appears to be definitely related to almost all physical phenomena, to mechanical stresses of all kinds, as well as to influences of temperature, chemical composition, and structure. The inter-relation between these phenomena is not sufficiently uniform, however, to allow of the determination of physical properties from magnetic tests.

Impact Tests.‡—G. Charpy discusses the present position of the impact bending test on notched bars, and concludes that this test furnishes useful information which is not yielded by the tensile test.

F. Schüle and E. Brunner§ have determined the volume of metal strained beyond the yield point, in impact bending tests on notched bars, and find that the influence of the depth of notch can be eliminated by calculating the work done in fracture per unit of this volume.

P. Breuil‖ states the conclusions he has drawn from a number of impact tensile tests on plain bars.

A. Leon and P. Ludwik¶ find that the amounts of work done in static bending and in dynamic bending are not in any uniform relation.

* Metallurgie, vi. (1909) pp. 407–8 (8 figs.).

† Proc. Int. Assoc. for Testing Materials, No. 6 (1909) 5 pp.

‡ Op. cit., No. 7 (1909) 20 pp. (Official Report on Impact Tests of Metals, submitted to the Copenhagen Congress, September, 1909.)

§ Op. cit., No. 6 (1909) 6 pp. (3 figs.).

‖ Op. cit., No. 10 (1909) 2 pp.

¶ Tom. cit., 2 pp.

Consequently there can be no uniform relation between static tensile test and notched bar impact test.

P. Welikhow * finds that impact tensile tests give numerical values which agree with the results of static tensile tests, and give in addition the kinetic strength of the material.

Irregular Stresses due to Non-homogeneity.†—A. Leon summarises the results of mathematical investigations concerning the irregular stresses which arise in elastic bodies owing to the presence of inclosures, hollow spaces, and superficial flaws. Inclosures of any kind will cause local increase of stress, and thus a diminution in the strength of the material. These increases in stress are greatest within the elastic range, and diminish rapidly when permanent deformations occur.

Thermo-electric Measurement of Elastic Limit.‡—E. Rasch deduces from theoretical considerations that when a metal is stressed in tension its temperature falls so long as its deformation is purely elastic, but rises when inelastic permanent deformation begins. A method of determining elastic limit founded on this property is described. The change of temperature of a tensile test-piece when submitted to increasing stress is followed by means of a thermo-couple placed in contact with the test-piece and connected to a delicate galvanometer. The critical stress—i.e. elastic limit—is indicated by a reversal in the temperature record.

Influence of Increased Temperature on the Mechanical Qualities of Metals.§—M. Rudeloff describes the various methods which have been employed for carrying out tensile and other mechanical tests at high temperatures. The results of high temperature mechanical tests made by the author and others on steel, cast iron, copper, brass, bronze, manganese bronze, and delta metal are summarised. A comprehensive bibliography is appended.

PORTEVIN, A.—**Binary Alloys.**

[A. Portevin has continued his account of the investigations carried out in G. Tammann's laboratory at Göttingen (see this Journ., 1908, pp. 522 and 787). The alloys of nickel, lead, antimony, silicon, tin, and zinc are here dealt with.]

Rev. Métallurgie, v. (1908) pp. 838–56, 909–27; vi. (1909) pp. 241–71, 951–82 (127 figs.).

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* Proc. Inst. Assoc. for Testing Materials, No. 10 (1909) 9 pp. (2 figs.)
† Op. cit., No. 9 (1909) 6 pp. ‡ Op. cit., No. 11 (1909) 7 pp. (2 figs.).
§ Op. cit., No. 12 (1909) 30 pp. (25 figs.).

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on the 20th of October, 1909, at 20 Hanover Square, W., E. J. Spitta, Esq., M.R.C.S., etc., Vice-President, in the Chair.

The Minutes of the Meeting of June 16, 1909, also those of the Special Meeting of the same date, were read and confirmed, and were signed by the Chairman.

The List of Donations, exclusive of exchanges and reprints received since the last Meeting, was read, and the thanks of the Society were voted to the Donors—special mention being made of the valuable contribution from Dr. Braithwaite.

	From
Walter Bagshaw, Elementary Photomicrography. (8vo, London, 1909)	*The Author.*
Arthur Terry Mundy, The Anatomy, Habits, and Psychology of *Chironomus pusio*. (4to, Leicester, 1909)	*Mrs. Mundy.*
F. Shillington Scales, Practical Microscopy. 2nd ed. (8vo, London, 1909)	*The Publisher.*
Wilhelm Behrens, Tabellen zum gebrauch bei Mikroskopischen Arbeiten. 2nd ed. (8vo, Braunschweig, 1892)	*Sir Frank Crisp.*
Report of the British Association, 1905, South Africa. (8vo, London, 1906)	*Ditto.*
Report of the British Association, 1907, Leicester. (8vo, London, 1908)	*Ditto.*
Moss Papers. 11 vols. of Pamphlets	*Dr. R. Braithwaite.*
John Macoun, Catalogue of Canadian Plants. (8vo, Montreal, Dawson Bros., 1883)	*Ditto.*
Seventy-seven Slides of Foraminifera from the late Wm. Kitchen Parker's Collection	*Mr. Ernest Heath.*
Two Electric Lamps	*Mr. J. W. Gordon.*
Slide of *Aulacodiscus superbus*	*Mr. J. T. N. Thomas*

Mr. Wynne Baxter said that the diatom slide presented by Mr. J. T. Norman Thomas was a very valuable present, as *Aulacodiscus superbus* was an extremely rare form, which had only been found four or five times. In 1860 Dr. Greville was giving his papers on the Diatomaceæ which had recently been found, and the bulk of the discoveries came from the same place as this *Aulacodiscus*—the Island of Barbados, which contained an unusually large number of chalky-looking calcareous and silicious deposits of deep-sea origin. *Aulacodiscus superbus* was one of the rare diatoms of the genus, all species of which were either marine or were found in marine deposits; they were all circular, and all nearly flat, with costæ, moniliform rays, or well marked sulci connecting the processes, which usually project: the peculiarity of this one being that it has a reticulation something like that seen in *Triceratium grande*. The only published illustration of it was by Mr. Kitton, printed in 1857

—which was placed on the table beside the Microscope under which the diatom was being shown; and if this figure was compared with the diatom itself, it would be seen how great an advance had been made in the perfection of objectives since that time, when it was described as being covered with a sort of mulberry elevation. They knew, of course, that specimens of the same species varied very much, and they must take this into consideration, but he thought the greater part of the difference observed was due to the improvement of the objective. He wished to thank Mr. Thomas specially for giving them this beautiful specimen.

Mr. E. Heron-Allen—in reference to the exhibition on the table that evening of Slides of Foraminifera from the collection of the late Mr. Wm. Kitchen Parker—said he had hurried down from the Council Meeting in order to inspect this collection under the impression that he would see something of particular interest, but what he saw reminded him of a story of the American who, on being shown a small skull said to be that of Oliver Cromwell, remarked that he had always understood that Oliver Cromwell had a very large head, whereupon the exhibitor explained that this was "the skull of Oliver Cromwell when he was a little boy." He thought that these slides must have been from the collection of W. Kitchen Parker when he was a little boy. When he remembered the multitude of papers on the Foraminifera published by the great triumvirate of Brady, Jones, and Parker—or Jones, Brady, and Parker, or Parker, Jones, and Brady—he thought he should have seen something quite exceptional in the way of species and specimens. The slides exhibited on the table gave him the impression that at the commencement of his career as a student of the Foraminifera Mr. Parker must have bought a new sponge, and the result of his examination of the sand obtained from it was before them that evening.

Mr. Earland said that the chief interest of the slides lay in their having once been in the collection of the late W. Kitchen Parker, for the specimens themselves had no particular value, and the mounts were very crude. He noticed, however, that one of the slides of Bognor shore-sand contained a typical British specimen of *Nubecularia lucifuga* Defrance. Now the slide was to all appearances more than fifty years old, while the species in question was not recorded in Britain until 1879. If Parker had noticed his specimen, the record would have been anticipated by many years. Parker's reputation as a rhizopodist was almost entirely based on his association with Rupert Jones and H. B. Brady, in conjunction with whom he published many papers of great value, especially from the point of view of systematic nomenclature. The exact share which Parker contributed to the partnership was unknown to him, but it was probably quite secondary to the contributions of the other two authors. Although Parker had a high reputation as a zoologist and comparative anatomist, he had, so far as he was aware, published only a single independent paper on the Foraminifera.

The Chairman thanked the last two speakers for their remarks with respect to these slides, which it was quite possible might have been put up by Dr. Parker at the commencement of his career; or else that they were presentation slides to him by different donors at various times, and which he had had the courtesy not to refuse. Anyhow, he felt sure the Fellows present would like to thank the donors for their kindly thought in sending the slides to the Society, and he dared say they would be found of some service.

Mr. C. Beck said that the lamp presented to the Society by Mr. Gordon was that which he had described at the Meeting in May. The principle of this illuminator was that the light was not taken direct, but by means of cylindrical glass rods, and in this instance three Microscopes could be illuminated by the same lamp. The light conveyed in this way overcame the difficulty met with through the image of the filament of an electric lamp appearing in the field when high powers and a focused condenser were used. It also had another advantage in the ease with which the intensity of the light could be regulated by moving the glass rod in or out of the brass tube so as to alter its distance from the lamp without disturbing any other arrangement. When a colour screen was introduced, it greatly reduced the light from an ordinary lamp, and it was a very difficult thing to increase the intensity of the light to a corresponding extent, but with this device it could be done without any trouble whatever. One end of the rod was ground and the other was clear, and a perfectly homogeneous area of light surface was obtained. (The lamp in question was placed upon the table for examination by the Fellows present.)

The Chairman said that an illuminant on this system used to be sold by Carl Zeiss about thirty years ago. It was said to give a good diffused light, but some seemed to think it was not altogether satisfactory for critical illumination.

Mr. C. L. Curties said that a lamp of this kind with bent glass rods was exhibited at one of the Society's Meetings by his father about twenty-five years ago; he believed it was made by a Berlin firm.

Mr. A. E. Conrady said that a lamp of this kind was made at Bonn by Koch, whose difficulty at the time was to get glass clear enough for the purpose.

Mr. Wesché inquired if this lamp could be used with the ordinary electric current supplied to a house.

The Chairman said the arrangement in front of him was provided internally with a 100-volt incandescent lamp. Mr. Gordon had very kindly presented the Society with two of these, which were intended to be used in series, as the electricians called it, which meant that the current from the main should pass first through one lamp and then through the other. The 200-volt system of the building was by this means suitably divided between the illuminants. If, however, it was desired at any time to employ one illuminant only, it would be necessary to change the internal 100-volt lamp for one that was constructed to carry 200, as in this case there was no dividing the main current with the twin illuminant. It was quite an easy thing to change the internal lamps, but they must be had in readiness, for if it were attempted to use the 100-volt internal lamp when the illuminant was employed by itself the filament would be immediately destroyed. He hoped he had made his meaning clear to Mr. Wesché.

A Fellow asked if a glass rod like that would work well with an arc lamp, because when used for photography a very little variation in the light from the arc would upset the process.

Mr. Beck said he had tried the lamp with an incandescent mantle and found it work very well, and he thought it would also work well with an arc lamp; the only thing in that case would be the question of heat. The object of the curved rods which had been referred to was to convey the light under or over the object. Mr. Gordon did not claim any originality for the principle, but the object originally aimed at was the conveyance of the light round a corner.

Mr. Taverner asked if there was any limit to the length of the glass rod to be used.

Mr. Beck thought that probably the rod should be as short as possible, because the absorption of light by glass was very considerable.

Mr. Orfeur said that when Mr. Gordon showed the lamp at the Meeting of the "Brass and Glass Section" he suggested that the length of the rods should be from 4 to 5 inches.

The Chairman said that although Mr. Gordon had, he believed, devised this lamp in the first place entirely himself, still he soon discovered his invention had been anticipated, as already explained, and he quite acknowledged it, although, of course—as Mr. Gordon rightly said—his suggestion embodied improvements that did not exist in the arrangement previously designed.

Mr. Heron-Allen asked if it could be used upon an opaque object.

Mr. Beck said Mr. Gordon had asked them to make a rather more elaborate lamp than the one before the Meeting, and he hoped to be able to show this at the next Meeting of the Society. A curved rod would enable opaque objects to be illuminated by it.

The thanks of the Society were specially voted to Mr. Gordon for his donation.

The Diploma of Honour awarded to the Society for their exhibit at the Franco-British Exhibition was exhibited to the Meeting by Dr. Hebb.

The Chairman said he was sorry to have to announce that, in consequence of what occurred at the Special Meeting of the Society in June last, Mr. Gordon had sent in his resignation as a Fellow. He (the Chairman) said he felt sure that all present would receive this notice with regret, because Mr. Gordon's papers had certainly stirred up the Society and induced much discussion; and although perhaps he, with several others, could not personally agree with all the conclusions arrived at or some of the opinions expressed, still no one present, he felt positive, entertained anything approaching ill-feeling towards the author on that account—anyhow, if they did, they ought not to, he felt equally certain. This made it all the more a pity that Mr. Gordon should have looked upon the opinions expressed at the last Meeting in so grave a way, and allowed them to induce him in consequence to act in so heroic a manner: this was especially to be regretted as it was common knowledge that no one usually met his opponents in a more generous and courteous manner than did Mr. Gordon on all previous occasions. No mention would have been made of the subject at all from the Chair had it not been necessary for the Council to find immediately a gentleman to assist Dr. Hebb in his secretarial duties, and they felt grateful to Mr. F. S. Scales for so readily responding to their request and coming to their rescue, anyhow, till the next election of officers. This, then, Gentlemen, the Chairman added, explains why we have the pleasure of seeing Mr. Scales in the chair formerly occupied by Mr. Gordon.

Mr. F. Chapman's paper, "On the Microscopical Structure of an Inoceramous Limestone in the Queensland Cretaceous Rocks," was read by Dr. Hebb, and illustrated by the plates to which reference had been made.

The thanks of the Society were unanimously voted to Mr. Chapman for his paper.

Mr. C. F. Rousselet called attention to a specimen of the rare spherical Rotifer, *Trochosphæra æquatorialis*, shown in the room that evening, which had never been exhibited in this country or anywhere else before. It came from Brisbane, Queensland, where it was first found in 1889 by Surgeon Gunson Thorpe, but had disappeared for a long time. This species, which was originally discovered about fifty years ago in the Philippine Islands by Professor Semper, is of peculiar interest, as it closely resembles in outward form the *Trochosphæra* larvæ of the marine worm *Polygordius*, and to this resemblance has been in great part due the theory that the Rotifera are derived from worms. The discovery of *Pedalion* has later thrown doubt on this derivation.

Mr. Wesché said that when he visited Brisbane Mr. Rousselet asked him to look up the particular pond where this Rotifer had been found, and if possible to procure some specimens. He was informed, however, that a tidal wave had washed out the pond and destroyed all that had been in it.

Mr. Wesché thought that this resemblance to a larval worm bore out Huxley's idea that the Rotifera were permanent forms of larvæ.

The Chairman said they must not only thank Mr. Rousselet for his communication and exhibit, but must congratulate him upon obtaining so rare a specimen.

It was announced that the "Biological and Bacteriological" Section would meet on November 3, at 7 for 7.30 p.m.: also that the "Brass and Glass" Section would meet on the fourth Wednesday in the month at the same hour.

New Fellows:—The following were elected *Ordinary* Fellows of the Society: John Gilbert Hare, John Frederick Haws.

The following Instruments, Objects, etc., were exhibited:—

The Society:—*Aulacodiscus superbus* (presented by Mr. J. T. Norman Thomas); 12 slides of Foraminifera, part of a donation from Mr. Ernest Heath; Diploma received from Franco-British Exhibition.

Mr. C. F. Rousselet:—*Trochosphæra æquatorialis*. Mounted specimen of a very rare Rotifer, from Queensland.

MEETING

HELD ON THE 17TH OF NOVEMBER, 1909, AT 20 HANOVER SQUARE, W.
F. J. CHESHIRE, ESQ., VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of the 20th of October were read and confirmed, and were signed by the Chairman.

The following Donation was announced :—

	From
Andrew Pritchard, A History of Infusoria, including the Desmidiaceæ and Diatomaceæ. 4th ed. (8vo, London, 1861) ..	*Mr. K. J. Marks.*

With reference to the copy of Infusoria, Desmidiaceæ, and Diatomaceæ presented by Mr. Marks, Dr. Hebb said they were very glad to get this, as though they formerly had it in their library upstairs, it had been borrowed by someone and had never been returned.

On the motion of the Chairman, a special vote of thanks was given to Mr. Marks for his valuable donation.

Mr. C. Beck exhibited and described a new form of speculum lamp devised by Mr. J. W. Gordon, which was a modification of the lamp exhibited at the last Meeting. It was mounted on a base having a raising motion. The light was furnished by an electric lamp, and was concentrated upon the surface of the end of a glass rod, the structure of the filament of the lamp being entirely broken up by internal reflection, so that a mass of homogeneous light was produced, coming out of the rod at an angle of not more than 15° or 20°. For critical illumination, the iris-diaphragm on the surface of the cylinder was a very useful adjustment, by means of which the surface of the illuminated field could be easily limited. In front of the source of light there was a little condenser, which could be independently focused, and in front of the tube a trough was provided—to contain a solution of sulphate of copper or other liquid, for producing monochromatic light, or a piece of monochromatic glass; or a piece of glass with a central patch could be introduced for obtaining dark-ground or oblique illumination. The great advantage of being able to modify the intensity of the light without disturbing any of the apparatus connected with the Microscope—which was a special feature of this kind of lamp—was obtained by racking the electric lamp to or from the end of the glass rod; the lamp could also be used very low down, as it could be placed almost close to the table. The whole of the apparatus was carried upon a block, so arranged that it could be swung in almost any direction, which rendered this an almost universal lamp. Where electric current was not available, an inverted gas-mantle could be effectively substituted, the structure of the mantle being completely broken up by the reflections inside the glass rod; this was further effected by the end of the rod next to the light being slightly and very finely ground, the outer end being polished.

Mr. Wesché noticed that the glass rod was inclosed in a brass tube, and inquired if this was in order to increase the reflection.

Mr. Beck said that this was merely for the purpose of protection.

Mr. Rousselet asked if the rod was large enough to enable the lamp to be used for low powers and dark-ground illumination.

Mr. Beck said that the lamp worked very well with low powers down to 1 or $1\frac{1}{2}$ in., but if wanted for low-power work it should be used with its condenser.

The thanks of the Society were voted to Mr. Beck for his exhibit.

A paper "On the Recent and Fossil Foraminifera of the Shore-sands of Selsey Bill, Sussex"—Part IV., by Mr. E. Heron-Allen and Mr. A. Earland, was read by Mr. Heron-Allen, who expressed his regret that Mr. Earland was unable through illness to be present on that occasion. The subject was illustrated by about ninety extremely fine lantern slides shown upon the screen, and by a large number of mounted specimens shown under Microscopes on the table. The indebtedness of the authors of the paper to Mr. A. E. Smith, who had prepared the photomicrographs from the mounts, to Mr. J. A. Lovegrove, who had prepared the lantern slides illustrating the objects, and to Mr. H. F. Angus, for arranging the exhibition under the Microscopes and upon the screen, was duly acknowledged.

Mr. Edmund J. Spitta said that as he knew so little about Foraminifera he could not say anything about these little "beasties" as Mr. Heron-Allen had called them, but he should like to convey his congratulations upon the excellence of the photomicrographs shown. These, the speaker said, were taken, he understood, by his old friend Mr. Smith, the slides being made by Mr. Lovegrove. Such large and thick objects as those in question offered difficulties peculiar to themselves and of no small moment, for be it understood it was absolutely impossible to show them in complete focus on account of their great thickness. The art of the operator was in the first place to settle which plane was the best to have in absolute focus, and in the second, to decide upon how much depth of focus was permissible. If the iris-diaphragm was closed too much for this purpose, all manner of diffraction phenomena presented themselves and the resulting photograph showed all sorts of false images which would lead astray those who looked upon the photograph as representing the real truth and nothing but the truth. Besides this too, seeing that closing the iris-diaphragm reduced the N.A. of the objective in use, so it reduced its resolving power also, and in consequence the photographer would not be able to show all the minute structure of the specimen in the plane of focus he had selected for that purpose. It would be understood then that two evils were apt to result by attempting to produce a too great depth of focus, the introduction of false details—details that did not exist but were optically caused; and the omission of fine details that perhaps were really present, but were prevented from being shown by the undue lowering of the numerical aperture. On the other hand, it must not be forgotten, the photographer was compelled to get a little depth of focus by closing his iris-diaphragm a trifle, for otherwise the object looked too flat and uninteresting. It was here, then, that the individuality of the operator came into play, and as Mr. Smith had apparently just hit upon the happy mean, he, the speaker, hoped he would allow him to offer his sincere congratulations.

The Chairman said they had listened to a very interesting paper, illustrated by some very beautiful lantern slides; indeed, the latter had been quite a treat in themselves. They also had a large number of Microscope specimens shown upon the table. He asked therefore that all present would join in an expression of thanks to Mr. Heron-Allen and Mr. Earland for their communication.

The vote of thanks having been put to the meeting was unanimously carried.

The following Instruments, Objects, etc., were exhibited:—

Messrs. R. and J. Beck:—A new form of Speculum Lamp for the Microscope, on the principle devised by Mr. Gordon.

Mr. Edward Heron-Allen, in illustration of the paper by himself and Mr. A. Earland, about ninety Lantern Slides of Foraminifera shown upon the screen, and the following slides under Microscopes:— (1) Typical Foraminifera of Selsey Shore-sand; (2) Common ditto ditto; (3) Selected ditto ditto; (4) Typical ditto ditto; (5) *Cycloloculina annulata*; (6) *Pulvinulina vermiculata*; (7) *Polymorphina hirsuta*; (8) Nummulites; (9) *Polystomella striato-punctata* var. *selseyensis*; (10) *Rotalia calcar*; (11) *Pulvinulina concentrica*; (12) *Planorbulina eocenica* (?), a species awaiting determination; (13) *Discorbina semi-marginata*; (14) *Discorbina cristata* sp. n.; (15) *Spirillina selseyensis* sp. n.; (16) *Polymorphina complanata*; (17) *Lagena orbignyana* var. *selseyensis*.

New Fellows:—The following were elected *Ordinary* Fellows of the Society: Messrs. Harold Squier Cheavin, Robert Denley James, Edwin Henry Kirby, Thomas R. Saxton.

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