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.

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FOR THE YEAR

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PROCEEDINGS OF THE SOCIETY.

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JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

FEBRUARY 1899.

TRANSACTIONS OF THE SOCIETY.

I.—*The Reproduction of Diatoms.* By J. Newton Coombe.

(*Read 19th October*, 1898.)

Plates I. and II.

In a paper read by Mr. George Murray, F.R.S.L. and E., F.L.S., before the Royal Society of Edinburgh, and published in the Society's Proceedings, vol. xxi. No. 33, the question as to whether diatoms are reproduced by spores or endocysts, in addition to their other known modes of reproduction, is brought from the region of speculation, in which it had been buffeted about for nearly fifty years, to that of actual observation.

In an article which I contributed to 'Le Diatomiste' (No. 21, June 1895), after suggesting that Dr. Miquel's failure, in his interesting laboratory cultivations, to discover any appearance of spores among the Diatomaceæ, may have been due to the fact that his investigations were made among artificial growths which it is possible were deficient in some of the elements necessary for the development, or even fertilisation, of diatom spores, if any such existed, I mentioned the case of a natural gathering of *Navicula radiosa* Kütz., in which I found "corpuscular bodies similar in colour, size, and shape to those seen in the interior of the largest frustules in the gathering, mixed with frustules of every size, varying from about 5 μ, the size of the corpuscles, to about 65 μ, the size of the largest frustule." In one of the illustrations which accompanied my article, and which I drew with the aid of the camera lucida, there is shown a frustule containing two round bodies apparently in the act of escaping from a full-sized frustule of the species indicated.

When my attention was directed to Mr. Murray's paper, I wrote to Professor Herdman, of the University College, Liverpool, and he very kindly made arrangements for my being supplied from the

Note.—The explanation of plates I., II. is given in the text. The magnification is cir. 144 for figs. 1, 2, 3, 5, 10, 11, 12, 13, 14, 15, 19, 20; cir. 260 for figs. 4, 6, 7, 8, 9, 16, 17, 18.

Port Erin Station of the Liverpool Marine Biological Committee with tubes containing the results of weekly tow-nettings made by the Curator during the early months of the present year, under conditions as far as possible similar to those recorded by Mr. Murray. At the same time I set to work to further examine and photograph the contents of several species of fresh-water diatoms, as to which I have for some years observed indications of their resolution into spore-like bodies similar to those noted by Mr. Murray in the case of the marine species. Although in the first instance the contents of the Port Erin tubes were fixed in accordance with Mr. Murray's formula, I soon found out that, for purposes of accurate observation and photography, it was essential that the diatoms should be examined while living as well as after death. Thanks to the exceeding pains taken by the Curator (Mr. H. C. Chadwick), and notwithstanding repeated failures, I was able to examine and photograph a sufficient number of living specimens in a fresh and healthy condition, to permit of the illustration of the observations of marine diatom reproduction recorded in the present paper.

Mr. Murray's discoveries led him to the conclusion that certain marine diatoms "may reproduce themselves, either by a rejuvenescence of the cell and the secretion of a new frustule within the parent (*Biddulphia, Coscinodiscus,* and possibly *Ditylum*) which, escaping on the separation of the parent valves at the girdle, may grow, divide, and multiply before fully attaining the characteristic external sculpturing and adornment of the parent (*Biddulphia*); or the number of the offspring may be increased by preliminary division of the protoplasm into two, four, eight, and sixteen (*Coscinodiscus*)."

Dealing first with the last named mode of reproduction, I have prepared ten photographs, the first six taken from the Port Erin gatherings made in February and March of the present year (1898), and the remaining four from fresh-water gatherings made in the neighbourhood of Sheffield about the same time.

Photograph No. 1 shows the contents of a *Coscinodiscus* dividing into two portions, such division being evidently not the ordinary process of diatom division, which would be invisible from the valve view at which the photograph is taken.

Photographs Nos. 2, 3, 4, and 5 are those of other frustules of the same species, taken from the same gathering as No. 1, in which the contents are dividing, or have divided, into four, eight, sixteen, and thirty-two spore-like bodies.

Mr. Murray infers from his interesting discovery in Loch Fyne of what he describes as "packets" of four, eight, or sixteen young *Coscinodisci* "held together in all cases by a fine membrane," that this division of the contents of the frustules is preliminary to the formation of these "packets."

Not having met with any such "packets"—which I take to be altogether different from the cysts containing "broods of diatoms" referred to in William Smith's Synopsis—I am unable to express any opinion upon them; but that the spore-like bodies shown in my photographs may develop into fully formed young diatoms before leaving the parent shell, I am satisfied, from the discovery in the Port Erin gathering of a frustule of *Coscinodiscus* containing eight pill-box like bodies, some of which presented valve and others girdle views similar to those of the parent, and all of which were so far silicified as to be capable of fracture upon pressure of the cover-glass. Unfortunately the lively movement of the diatom prevented me from obtaining more than a blurred photograph of the young frustules; and in refilling the cell after evaporation of the water, I lost the specimen, and did not succeed in finding another similar one.

Photograph No. 6 is that of a portion of a filament of *Chætoceros* taken from the valve view, in which the contents of one of the frustules have divided into two egg-shaped bodies, which under the Microscope (but not as focussed when photographed) are seen to be again dividing into four bodies.

Photograph No. 7 is that of a filament of the fresh-water diatom *Eunotia pectinalis* (Kütz.) in which the contents of the frustules are clearly shown to be dividing from two into four portions, and there seems no reason to doubt but that this is again similar to what takes place in the case of the marine diatoms already mentioned.

Photograph No. 8 is that of a living filament of the fresh-water diatom *Melosira varians*, in which the contents of several of the frustules have divided into spore-like bodies by a process similar to that in *Chætoceros* and *Eunotia*.

Photograph No. 9 is that of the fresh-water diatom, *Meridion circulare*, showing the resolution of the contents into spherical bodies, which, it seems fair to infer, although I have not been able to observe it as in the case of *Eunotia* and *Melosira*, has taken place by a process of division similar to that in those diatoms.

Dealing next with the mode of reproduction described by Mr. Murray as a "rejuvenescence of the cell and the secretion of a new frustule within the parent, which, escaping on the separation of the parent valves at the girdle, may grow, divide, and multiply before fully attaining the characteristic external sculpturing and adornment of the parent," I have been fortunate enough to obtain photographs from the Port Erin gatherings entirely confirming Mr. Murray's observations in regard to *Biddulphia* and *Coscinodiscus*, and establishing the occurrence of a similar phenomenon in regard to *Ditylum* and *Guinardia*.

Photographs Nos. 10 and 11 are those of three living frustules of *Biddulphia*, the contents of which have been rounded off as described by Mr. Murray.

Photographs Nos. 12 and 13 would appear to be those of further stages in this particular process of reproduction, No. 12 being apparently that in which the rounded off contents, after undergoing further contraction than Nos. 10 and 11, have secreted and become enveloped by a membranous sac, and have divided into two portions.

No. 13 shows two of these young *Biddulphias,* the contents of which have become diffused over the whole area of the diatom, and are no longer concentrated in the centre. I have observed dozens of such cases in the Port Erin gathering.

The next stage, which I have not thought it necessary to photograph, as not being very easily distinguishable from the fully developed frustule, is that of a delicate looking almost transparent frustule of the same form, and with similar spines to those of the fully developed *Biddulphia.* These were frequent in the gathering.

Photographs Nos. 14 and 15 are those of frustules of *Coscinodiscus,* the contents of which have been rejuvenised as in the case of *Biddulphia.* I have observed a large number of similar cases in the Port Erin gatherings, in all of which the valves of the young diatoms have been silicified and "sculptured" before leaving the parent. As to whether the young *Coscinodiscus* or the young *Biddulphia* increases in size after leaving the parent frustule, in either of the modes of reproduction dealt with in this paper, is no doubt a question of considerable difficulty ; but, judging from a series of photographs I have taken in illustration of the phenomenon of the formation of megafrustules after conjugation, I am inclined to the opinion that the increase in size of the newly formed diatom is attained by the last named process rather than by superficial growth, which my own observations lead me to think ceases after the young diatoms leave the protection of the parent cell. I do not think Mr. Murray's experiment of treating the young diatoms by burning and nitric acid "plainly warrants the conclusion" that, not being sufficiently silicified to stand the process, their capacity for increase in size may be assumed.

Photographs Nos. 16, 17, and 18 are those of *Ditylum Brightwellii,* also found in the Port Erin gatherings. They appear to be clear cases of rejuvenescence of the cell and secretion of new frustules within the parent.

Photographs Nos. 19 and 20 are those of frustules of *Guinardia,* which were not unfrequent in the Port Erin gathering, and are good illustrations of rejuvenescence.

All the photographs of the marine diatoms, with the exception of Nos. 4, 6, 16, 17, and 18, show a magnification of 180 diameters. The remainder of the photographs, including all those of the fresh-water diatoms, show a magnification of 325 diameters.

SHEFFIELD : *Sept.* 1898.

ADDENDUM.

Since writing the above paper, in a tube sent me from Port Erin, containing the results of a tow-netting made by Mr. Chadwick the previous day, and fixed by a weak solution of chromic acid, I have

[At foot of page 5.

Note.

By an unfortunate mischance, Figs. 21, 22, referred to in the "Addendum," are not included in the two Plates in the present Part.—Ed. *Journ. R. M. Soc.*

found what appears to be pretty clear evidence that *Biddulphia* is reproduced by the division of the contents of its cells into spore-like bodies, as well as by the secretion within its valves of new frustules; and also that *Chætoceros* must be added to those marine diatoms which reproduce themselves by rejuvenescence of the cell and the secretion of a new frustule within the parent.

Photograph No. 21, taken at a magnification of 180 diameters, is that of a frustule of *Biddulphia,* in which may be clearly seen the outlines of the valve view of two young *Biddulphias,* the contents of each of which have become divided into numerous spore-like bodies similar to those in *Coscinodiscus* (photo. No. 5).

Photograph No. 22 is also that of a frustule of *Biddulphia,* containing two young *Biddulphias.* This photograph is chiefly interesting on account of the young individuals being so far developed within the parent valves as to bear both girdle and spines, and therefore presumably to be incapable of growth; whereas in the cases already shown (photos. 10, 11, 12, and 13) there was an intermediate stage, during which the contracted contents of the parent frustule, having secreted a non-siliceous membrane or sac of the same shape as the parent, but without any trace of spines, underwent self-division, and were apparently capable of growth after leaving the old valves, but before silicification took place (photo. No. 12).

II.—*Bryozoa from Madeira.* By Arthur Wm. Waters.

(*Read 16th November,* 1898.)

Plate III.

Bryozoa from Madeira, collected by Mr. J. Yate Johnson, were described by Busk in a series of papers in the Quart. Journ. Mic. Sci.;* and in 1880, Mr. Hincks,† in the Annals and Mag. Nat. Hist., gave a description of some specimens received from the same source, bringing the number of species up to 75. The Cyclostomata have not yet furnished many species; but in 1897, Mr. J. Y. Johnson ‡ wrote a short paper enumerating six new species.

EXPLANATION OF PLATE III.

Fig. 1.—*Cellepora janthina* Smitt × 25.
,, 2. ,, ,, × 50.
,, 3. ,, ,, Operculum × 85.
,, 4.—*Lepralia contracta* sp. n. × 25.
,, 5. ,, ,, Operculum × 85.
,, 6. ,, ,, Aperture × 85.
,, 7.—*Schizoporella pes anseris* Smitt. Mandible × 85.
,, 8. ,, ,, Operculum × 85.
,, 9. ,, *vulgaris* Moll. Base of mandible × 250.
,, 10. ,, ,, Mandible × 85.
,, 11. ,, ,, Operculum × 85.
,, 12.—*Cellepora sexspinosa* sp. n. × 25.
,, 13.—(?) *Phylactella punctigera* sp. n. Operculum × 85.
,, 14. ,, *labrosa* Busk. Operculum × 85.
,, 15.—*Lepralia mucronelliformis* sp. n. Operculum × 85.
,, 16, 17. ,, *cleidostoma* Smitt. Opercula from same colony.
,, 18.—*Membraniporella nitida* Johnston. Mandible × 250.
,, 19. ,, ,, Operculum × 85, showing it continuous with the membrane.
,, 20.—*Lepralia peristomata* nom. n. Operculum × 85.
,, 21. ,, *mucronelliformis* sp. n. × 25.
,, 22.—*Pasythea eburnea* Smitt. Operculum × 250. *a* × 85.
,, 23.—*Schizoporella venusta* Norm. Operculum × 250. *a* × 85.
,, 24.—*Smittia* (*Porella*) *nitidissima* Hincks. Dorsal surface × 25.
,, 25.—*Lagenipora lucida* Hincks. Partly diagrammatic, showing the position of the ovicell and of the operculum (see dotted line) × 25.
,, 26. ,, ,, Operculum × 85.
,, 27. ,, ,, Showing the formation of the area of the ovicell × 25.
,, 28. ,, ,, Oral avicularian mandible × 250.
,, 29. ,, ,, Vicarious avicularian mandible × 85.
,, 30. ,, ,, Ovicell × 25.
,, 31.—*Cribrilina Balzaci* Aud. Operculum × 85.
,, 32. ,, ,, Dorsal surface × 25.
,, 33.—*Lepralia Pallasiana* var. *strumata* n. Operculum × 85.
,, 34. ,, ,, × 25.

* Vol. vi. p. 124; vol. vi. p. 261; vol. vii. p. 65; vol. viii. p. 280: n.s., vol. i. p. 77.
† Ann. Mag. Nat. Hist., ser. 5, vol. vi. p. 69. ‡ Op. cit., ser. 6, vol. xx. p. 60.

At Mr. Johnson's request, I have examined a collection which he sent to me for the purpose, and am able to add 26 to the lists already given, making a total of 93, and have been able to make preparations of the chitinous parts of several species.

The Membraniporidæ I have dealt with in a paper recently published by the Linnean Society.*

Out of 93 species now known, the large proportion of Mediterranean forms (51) is very noticeable; and no doubt direct comparison of some of the other species would establish further identity between the two districts. As the lists are more complete for the district of the Bay of Naples than for other Mediterranean localities, we might almost write Neapolitan instead of Mediterranean.

The number of species common to the British area is 36, and there are 16 Floridan species.

Unquestionably, there are still many other species to be found off Madeira, as no Ctenostomata are known, and we may feel sure that more than one Flustra and one Cellaria occur; and other similar cases might be mentioned.

This collection shows how much a careful revision of the three genera Schizoporella, Lepralia, and Cellepora is required; and at one time I intended to do something in this direction in connection with the present paper. We are finding in various families that there are groups in which there is a co-relation between the shape of the aperture and the form of the ovicell; and by carefully examining these characters, and any others that are available, we shall be led to distinguish many natural groups.

Schizoporella at present includes species having an aperture with a nearly straight edge and a median slit into which a movable tongue fits, as *S. Cecilii* Aud., *S. circinata* MacG., *S. pes anseris* Smitt (fig. 8). Then there are some with a median slit, but without a movable tongue, as *S. vulgaris* Moll (fig. 11), *S. acuminata* Hincks, *S. cribraria* H., &c., and *S. auriculata* Hass., in which the sinus is wider. In the next group the inferior margin is a wide curve, and it does not seem correct, where the lower lip is the segment of a circle, to speak of "a sinus on the lower lip," and the use of the term sinus requires restriction. Here we must place *S. biaperta* Mich., *S. marsupifera* B., *S. tumida* Hincks, *S. furcata* B., *S. lævigata* Waters. The opercula of this group are similar to those of *Cellepora pumicosa* Busk, *Lagenipora lucida* H., &c., having the muscular dots in the same position; and the opercula of Rhynchozoon are almost the same, though the muscular dots are nearer to the border.

Another group of Schizoporella has a more triangular operculum, as *S. triangula* H., *S. arrogata* Waters, *S. venusta* Norm. (fig. 23), *S. subimmersa* MacG.

In Lepralia, the operculum has a ridge at the side for the muscular attachment, and among the Lepraliæ there are forms in

* Journ. Linn. Soc. (Zool.), vol. xxvi. p. 654, pls. xlvii.–xlxix.

which the operculum is much contracted at the side, as for instance, *L. cleidostoma* Smitt (figs. 16, 17), *L. rectilineata* H., *L. Poissonii* Aud., and to these must be added *L.* (*Schizoporella*) *cryptostoma* MacG., *L.* (*Schizoporella*) *Woosteri* MacG. Then there are others in which the sides are nearly straight, as *L. Pallasiana* Moll, *L. Pallasiana* var. *strumata* Waters (fig. 33), *L. mucronelliformis* Waters (fig. 15), *L. peristomata* Waters (fig. 20), *L. striatula* H., *L. eliminata* Waters, *L. castanea* B.

In Cellepora, MacGillivray has separated the schizostomous forms from the holostomous, the latter being represented by *C. albirostris* Smitt, *C. pertusa* Smitt, &c., &c., most of which have a widely open ovicell; and he has placed all the forms in which the lower edge of the aperture is not approximately straight under Schismopora, but certainly Schismopora contains many divergent forms.

There is a Lagenipora group in which the ovicell has a flattened part, or area, which is usually perforated. There is, as a rule, a tubular projection, and the ovicell is above the operculum (fig. 25). The opercula have the muscular dots (fig. 26) some distance from the border, and usually about equidistant from the proximal and distal edges, though sometimes much nearer to the distal edge. This is represented by *L. Costazii* Aud., *L. lucida* Hincks, &c. (see p. 13).

Cellepora avicularis H., *C. coronopus* S. Wood, *C. dichotoma* H., have perforated ovicells, and perhaps they should form another group.

As I have mentioned, it is unfortunate that MacGillivray, in separating a small section of the Celleporidæ, should have retained for that the name Cellepora, giving the name Schismopora to the large and somewhat heterogeneous group which will have to be broken up. This necessity to divide up Cellepora has long been recognised, and if a new name had been given to the holostomatous group, then Cellepora could have been provisionally retained for the others. I hope shortly to attack the Celleporidæ.

Cellepora ampullacea B., *C. ramulosa* L., *C. dichotoma* H., *C. janthina* Smitt, are put provisionally under Cellepora of the older authors, while *Cellepora sardonica* W. is the Cellepora of MacGillivray.

Cribrilina setosa sp. nov.

Cribrilina radiata Moll var. *a* Hincks, Brit. Mar. Polyz., p. 186.

From an examination of specimens from Madeira and Naples, I cannot agree in calling this form with vibraculæ a variety of *radiata*. In *C. radiata* there are a number of avicularia scattered among the zoœcia; these are elongate, and no avicularian bar is developed; whereas in *C. setosa*, none of these elongate avicularia occur, but on each side, proximally to the oral aperture, there is a seta which is no doubt vibraculoid, but I have not yet had the opportunity of examining the muscular attachment. These setæ are very delicate, and are easily overlooked. Below the aperture, instead of the median pore enclosed in a triangular space, there are several pores, and the first rib occurs below these.

This is much like *C. Gattyæ* B., and should perhaps be called a variety, but it differs in not having so small an area, and in the small pores being in regular rows between the ribs; whereas in *C. Gattyæ*, the pores are larger and are not regularly placed.

It is impossible to say whether the *Flustra Pouilletii* Aud. is *C. radiata* or *C. setosa*, though probably it is the latter.

The operculum is the same size as that of *C. Gattyæ* B., which is smaller than that of *C. Balzaci*. Both have a similar muscular ridge at each side.

Cribrilina Balzaci (Aud.), plate III. figs. 31, 32.

Flustra Balzaci Savigny, Description de l'Égypte, pl. ix. fig. 8.

Lepralia cribrosa Waters, Ann. Mag. Nat. Hist. ser. 5, vol. iii. p. 36, pl. ix. fig. 4.

Collarina cribrosa Jullien, Bull. Soc. Zool. de France, vol. xi. p. 7.

Cribrilina punctata Hincks var., Ann. Mag. Nat. Hist., ser. 5, vol. xvii. p. 266.

A specimen from Madeira, which had been submitted to Mr. Busk, was marked by him "*Balzaci*"; and although Savigny did not show the avicularia, I think it most probable that Savigny had this species before him; and as there has been doubt expressed as to whether my *C. cribrosa* is the species of Heller, it would seem better to accept Audouin's name. In a specimen from Villefranche s. Mer, I do not find any avicularia.

The basal chambers are very marked in this species, and I referred to them and figured them in my paper on 'The Bryozoa of the Bay of Naples.' On the outside of the pore-chamber there is a large opening, and on the inside a watchglass-like rosette-plate.

There are 3–5 oral spines.

The small size of the area and the small pores distinguish this from *C. punctata* Hass., with which there are points of resemblance, and I think this is the variety which Hincks described from the Adriatic. It more nearly resembles *C. Gattyæ* Busk than *C. punctata* Hass.

Loc. Naples, Capri, Rapallo, Gulf of Taranto, Villefranche sur Mer, Madeira.

Lepralia multispinata Busk.

Lepralia multispinata Busk, Q. Journ. Micr. Sci., n.s., vol. i. p. 78, pl. xxxii. fig. 5.

The ovicell, which was not seen by Busk, is recumbent, granular, not perforate, and in shape and position reminds us of that of *Phylactella labrosa* B. The aperture is similar to that of *Lepralia peristomata* W. This has no lyrula, and is quite a different thing from

Mucronella ventricosa var. *multispinata* Busk, with which, however, Busk unites it.

Lepralia cleidostoma Smitt, plate III. fig. 16.

Lepralia cleidostoma Smitt, Floridan Bryozoa, p. 62, pl. xi. pp. 217–219.

There is more variation in the width of the operculum than is at all usual in the Bryozoa. Whether this difference indicates that the aperture of sexually mature zoœcia is different from the others, cannot be decided from the specimen examined, nor has the specimen any ovicells. This is much like *L. hippopus* Smitt, as already pointed out by Smitt, but differs in having triangular avicularia.

Lepralia Pallasiana var. *strumata*, plate III. figs. 33, 34.

This differs from typical *L. Pallasiana* in having a collar below the aperture extending across the zoœcium, and from the resemblance in this respect to *P. struma* Norm. I have called it var. *strumata*. It also differs from the *typica* and var. *projecta* in my collection in having a smaller aperture. *L. Pallasiana typica* is unknown with an ovicell, but ovicells occur frequently on what I called var. *projecta*, and they are also abundant on the specimens before us; and Mr. Hincks described one from Madeira with ovicells, but he does not mention any collar, though it is possible that it was this variety in which the collars were slightly developed. The collars commence as a series of tubercles, and then there is little to distinguish it from *typica*.

The ovicell has several large pores, and is closed by the oral operculum, and is closely united to the cell above.

This is very similar to the *Lepralia* (*Phylactella*) *columnaris* of Kirkpatrick, from Mauritius, in which, however, judging from the figure, the ovicells are much smaller.

Lepralia peristomata nom. nov., plate III. fig. 20.

Lepralia Mangnevilla Busk, Q. Journ. Micr. Sci., vol. viii. 1860, p. 284, pl. xxxi. fig. 5.

I do not think that the Madeira species described by Busk is the same as Audouin's *Cellepora Mangnevilla*, and have therefore given it a new name. Audouin does not show the ovicells immersed, nor a pronounced peristome, and he figures avicularia by the side of the aperture as they occur in *Smittia trispinosa*.

The present form would have to be placed under *Phylactella*, if that genus were recognised, but the raised peristome is known in so many genera that *Phylactella* cannot be retained. The broad band at the side of the operculum indicates the position of peristomata under *Lepralia*.

The specimen which I mentioned as *Mucronella canalifera* Busk,*

* 'Challenger' Supp. Report, pt. lxxix. vol. xxxi. p. 24, pl. iii. fig. 44.

collected by the 'Challenger' Expedition between Fayal and Pico, must remain as *canalifera*, as it differs in having the ovicell thrown back and not imbedded in the next zoœcium; it has not the large punctures, the peristome is different, and, what is of most importance, the opercula of the two forms show characteristic differences. Mr. Busk makes *L. canalifera* B. a synonym of his *L. Mangnevilla* Aud.; but from the above comparison we must take it that there are two species from localities not far apart.

Lepralia mucronelliformis sp. nov., plate III. fig. 21.

Zoœcia ovate, distinct, large; the end of the pore-tubes which pass to the base form a circular line on the front; surface granular and on the outer part punctured; a small mucro turned over the aperture, but not directed inwards. Oral aperture with the distal end rounded, the sides and proximal edge nearly straight, with lateral denticles. Operculum with the muscular ridges at the side. There are six oral spines. On one or both sides, lower down than the aperture, a raised triangular avicularium, with a complete bar. The avicularia are pointed downwards, and are often of very unequal size. Ovicells unknown.

The name is given in consequence of the similarity in appearance to *Mucronella coccinea*.

Lepralia contracta sp. nov., plate III. figs. 4–6.

Zoœcia incrusting, distinct, ovate or rectangular; surface granular; pores round the border not always distinct. Small semicircular or large spatulate avicularia at the side of the oral aperture. Oral aperture contracted at the side and rounded below; six oral spines. Ovicell with the front perpendicular, flat, with an area like that of *Schizoporella biaperta*. One specimen has neither avicularia nor ovicells.

Schizoporella vulgaris (Moll), plate III. figs. 9, 10, 11.

This was described from Madeira by Busk as *Lepralia alba*, and the specimens examined by me do not show the umbo which occurs frequently on the Naples specimens. The zoœcia and oral apertures are both somewhat larger than in the Naples specimens. To each zoœcium there are about twenty pore-chambers.

Loc. British; Naples, Rapallo, Villefranche s. M., Adriatic (H.), Madeira, Toulon (P.), Palavas (P.), Gulf of Gascogne. Fossil in the Tertiaries from various localities.

Schizoporella pes anseris (Smitt), plate III. figs. 7, 8.

Hippothoa pes anseris Smitt, Floridan Bryozoa, p. 43, pl. vii. figs. 159, 160.

Mastigophora Dutertrei var. *pes anseris* Kirkpatrick, Ann. Mag. Nat. Hist., ser. 6, vol. i. p. 77.

The operculum of this species has the proximal edge straight with a movable "appendage" in the middle, which fits into a small notch, and is but slightly attached to the upper part of the operculum. The opercula of *S. Cecilii* Aud. and *S. circinata* MacG. are similar, and I have alluded elsewhere to this structure, and figured the operculum of *S. circinata* MacG. In all these species the ovicells are smooth.

The curious webbed mandibles have the base symmetrical and not working in a socket, so that there does not seem to be any reason for considering the appendages vibracular. The mandibles are larger than those of any species with which I am acquainted. Mr. Busk speaks of *S. vulgaris* having vibracula, but according to my interpretation they are avicularia.

Pasythea eburnea (Smitt), plate III. fig. 22.

Gemellipora eburnea Smitt, Floridan Bryozoa, p. 35, pl. vii. figs. 152–156, and pl. ix. figs. 177, 178. *Pasythea eburnea* Busk, Zool. Chall. Exp., pt. xxx. p. 5, pl. xxxiv. fig. 1.

The operculum is complete, and is similar to that of *P. tulipera* Ell. and Sol., but I have not had the opportunity of making a preparation of the last species.

As the genera *Pasythea* and *Liriozoa* were created about the same time, it has seemed advisable to follow Busk, and to take the genus of Lamouroux.

Pasythea is placed with Hippothoa and Eucratea under Eucrateadæ by Busk, whereas Hippothoa and Gemellipora are put under the sub-family Schizoporellinæ by MacGillivray; and I should agree in placing this under Schizoporellinæ, for the operculum is very similar to that of *S. venusta* and of some other forms now considered to belong to Schizoporella. Found up to 450 fathoms by the 'Challenger.'

Loc. Florida (Sm.); Gulf of Gascogne (specimen sent to me by the late Dr. Jullien); 'Challenger' Stations 23, 24 (West Indies), 122 (off Brazil), and off Barra Grande, Brazil; Madeira.

Cellepora sardonica Waters.

Cellepora sardonica Waters, Ann. Mag. N. Hist., ser. 5, vol. iii. p. 196, pl. xiv. figs. 2, 5, 5*a*, 6; Journ. Micr. Soc. ser. 2, vol. v. pp. 776 and 778, pl. xiv. fig. 39.

In my paper 'On the use of the Avicularian Mandible in the determination of the Chilostomatous Bryozoa,' I have shown that the columella occurs in the round form of avicularia, but not in the triangular one, and that probably Busk examined only the latter when he stated that the columella was wanting. The ovicells have a circular line marking off an area. The young stage of a large number of *Celleporæ* is very similar, growing at first adnate and regularly, so that it is only in the older parts that there is any heaping up of the

* Quart. Journ. Geol. Soc., vol. xliii. p. 64, pl. viii. fig. 41.

zoœcia; then there is an avicularium on a more or less raised prominence below the aperture, but somewhat to the side. Smitt's figures of *Cellepora* (*Discopora*) *albirostris* would apply very well to the early stage of *C. sardonica* and other species, and determination will often only be possible by means of the opercula and mandibles.

Loc. Naples, Adriatic, Villefranche s. Mer, Madeira.

Lagenipora lucida Hincks, plate III, figs. 25–30.

Lagenipora lucida Hincks, Ann. Mag. Nat. Hist., ser. 5, vol. xiii. p. 30.

Phylactella lucida Hincks, Ann. Mag. Nat. Hist., ser. 5, vol. vi. p. 79, pl. x. fig. 4, 1880.

Cellepora Boryi Waters, Ann. Mag. Nat. Hist., ser. 5, vol. iii. p. 195.

Cellepora granum Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. viii. p. 68, pl. iii. fig. 8, 1881; and ser. 6, vol. ix. p. 330; Waters, op. cit. vol. xx. p. 198; ser. 6, vol. iv. p. 19; Busk, Zool. Chall. Exp., pt. xxx. p. 205, pl. xxxvi. fig. 10.

Lagenipora nitens MacGillivray, Trans. Roy. Soc. Victoria, 1886, p. (2), pl. i. fig. 1; Zool. Victoria, dec. xvi. p. 209, pl. clvi. fig. 3.

Now that I have seen several specimens, and have found the ovicells and spatulate avicularia, which do not seem to have occurred in Mr. Hincks' specimen, there is no doubt that this is the same thing as *C. granum* Hincks; for opercula and vicarious avicularia exactly correspond, and it is an open question whether the earlier name or the one with the fuller description should be taken.

As seen in sections of New South Wales specimens, there are 12–13 tentacles, and there are glands by the operculum. It now seems probable that the *C. Boryi* Aud. is what I called *C. retusa* var. *caminata*.

As I have already pointed out, we have a group of Celleporidæ with the operculum nearly round, and the muscular dots not very near the border, a somewhat tubular zoœcium with sub-globular ovicells above the oral aperture, but with the peristome usually extending above the ovicells, and the ovicells with a distinct area surrounded by elongate or radiating pores; usually vicarious avicularia.

In the group are included *C. granum* H., *C. Costazii* Aud., *C. costata* MacG., *C. caminata* W., *C. platalea* MacG., *C. rota* MacG., *C. rudis* B., *C. bilabiata* B., *C. signata* B., *Lagenipora spinulosa* H., *L. Edwardsii* Jull., and *Lekythopora hystrix* MacG. Perhaps the synonyms should be further reduced. The *Lagenipora tuberculata* MacG., I believe, is the same as *Anarthropora horrida* Kirkpatrick, and I should not place it with Lagenipora.

The above group will have to be separated generically; and although more weight is now put upon such characters as are furnished by the operculum and ovicell, and less on the manner of colonial growth, they can all stand as Lageniporæ. My specimen of *Lagenipora socialis* from Hastings, though rather a poor one with only one ovicell, shows that the ovicell has a raised line marking off an area, but I am unable to see what the ornamentation is. Hincks did not notice the area.

Loc. Naples, Madeira, Victoria, New South Wales, New Zealand, Bass's Straits.

Cellepora janthina Smitt, plate III. figs. 1, 2, 3.

Cellepora edax var. *janthina* Smitt, Floridan Bryozoa, p. 63, pl. xi. figs. 224, 245.

Zoarium incrusting, or disk-shaped like *Orbitulipora*, zoœcia distinct, short, ovate ventricose, punctured, sometimes with a central umbo, and with a triangular avicularia on one or both sides below the oral aperture; oral aperture very nearly round, with a denticle at each side. Ovicells globular, granular, very widely open and much raised.

In using the name Cellepora, it is recognised that with modification of classification it may have to be placed elsewhere, and Hincks has proposed the genus Cyclicopora for forms with a round aperture; but I am not at present prepared to remove the Madeira form to that genus.

This is much like the *Eschara cyclostomata* of Moll (non Busk), Seerinde, p. 63, pl. iii. fig. 12; and Busk has described *Cellepora ampullacea* from Madeira, which has a round aperture.

Rhynchozoon bispinosa var.

There are two or three specimens of a Rhynchozoon with very numerous small papilliform avicularia scattered over the surface. The opening under the mandible is slit-like and much smaller than the mandible, and the avicularia resemble those of *R. crenulata* Waters, and it may be this species, but I hesitate to unite them from the specimens which I have examined. Round the border of the zoœcia there is a row of large pores. The ovicell is entirely immersed, with an area placed vertically. The operculum is similar to that of *R. bispinosa*, and there are only very minute lateral teeth, whereas in *R. crenulata* the pronounced lateral teeth give the aperture a Lepralia-like appearance.

Rhynchozoon bispinosa (Johnst.).

One specimen has a few elevated avicularia with acute triangular mandibles, without a complete bar to the avicularium. The border of the aperture is slightly crenulated.

Smittia (*Porella*) *minuta* Norman var. *punctata* nov.

Two small specimens, in size resembling the *Porella minuta* of Norman, differ in having the surface of the zoœcia and of the ovicells regularly punctured. The ovicells are subimmersed. This is, of course, closely allied to *P. concinna* B., which is subject to considerable variation. It has a broad lyrula (denticle), whereas Hincks, in his Brit. Mar. Polyzoa, says *P. minuta* has no denticle; but in a specimen from Hastings, in my collection, there is a broad lyrula placed very deep down, so that it is easily overlooked.

Porella nitidissima Hincks, plate III. fig. 24.

Porella nitidissima Hincks, Ann. Mag. Nat. Hist., ser. 5, vol. vi. p. 78, pl. x. fig. 2; Kirkpatrick, op. cit. ser. 6, vol. i. p. 81.

Specimens in Mr. J. Y. Johnson's collection have many zoœcia without the lateral avicularia; in fact, in the first specimen examined I did not notice them. The surface of the zoœcium and of the ovicell is pitted all over. On the dorsal surface there are about six distal pore-chambers, while the lateral walls are merely perforated by the rosette plates without any chambers. This seems closely allied to *P. concinna*.

Loc. Madeira, Mauritius.

? *Phylactella punctigera* sp. nov., plate III. fig. 13.

Although I do not think the genus *Phylactella* can stand as at present defined, since the elevated peristome occurs in widely divergent genera, yet we may find that some members form a group furnishing other characters in common, and, therefore, as the present form is closely allied to *P. labrosa*, the name is provisionally retained.

It differs from *P. labrosa* Busk in having no median denticle. The ovicells are punctured, and the operculum has the thickened band a short distance from the border, as in *P. labrosa*, which seems to furnish a proof of the relationship of the two species. Under *Phylactella* rather widely divergent forms have been placed, as for instance *Lagenipora* (*Cellepora*) *lucida* Hincks.

? *Phylactella labrosa* (Busk), plate III. fig. 14.

For synonyms see Hincks, Brit. Mar. Polyz., p. 357.

Hincks gives the ovicell punctured; whereas Busk, who does not mention the denticle in the aperture, says the ovicell is smooth, and it is possible that a mistake has been made, or else the species is subject to this variation. At any rate the Madeira specimen agrees with Mr. Hincks' description and figure. I have not been able to figure a perfect operculum.

In the collection sent to me, I have, besides the species mentioned, seen the following, and have added a star to those not previously noticed as occurring off Madeira.

**Alysidium Lafontii* Aud., *Scrupocellaria Delilii* Aud., **Beania hirtissima* Hell., *Membraniporella nitida* Johnst, *Onychocella angu-*

losa Reuss, **Micropora coriacea* Esper., *Cribrilina radiata* Aud., *Lepralia multispinata* Busk, *Lepralia Pallasiana* Moll, *L. Poissonii* Aud., *Schizoporella biaperta* Mich., *S. sanguinea* Norm., *S. vulgaris* Moll, *S. discoidea* B., *S. unicornis* Johnst., *S. auriculata* Hass., *S. armata* Hincks, *S. venusta* Norm., *S. pes anseris* Smitt, **Hippothoa divaricata* Lamx., **Pasythea eburnea* Smitt, *Cellepora ramulosa* L., **C. dichotoma* H., *Lagenipora Costazii* Aud., **Rhynchozoon bispinosa* Johnst., **Smittia Landsborovii* Johnst., **S. trispinosa* Johnst., **S. coccinea* Abild., *Porella nitidissima* Hincks, **Retepora Couchii* B., **R. atlantica* B., *R. Solanderia* Risso.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, Etc.

*Including Original Communications from Fellows and others.**

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Inversion of Germinal Layers in Primates.‡—Prof. E. Selenka gives a preliminary account of the inversion which he has observed in *Semnopithecus nasicus* and *Hylobates concolor*, and which probably occurs in *Homo* as well. As in other cases, it seems to be due to a coalescence of a villus-bearing portion of the blastodermic vesicle with the uterine epithelium during the process of gastrulation.

Degeneration of Villi in Large Intestine of Guinea-pig.§—Dr. D. Schirman finds that the villi abundantly present in the large intestine of the embryos of this mammal consist of epithelial cells for the upper four-fifths of their length, only the basal fifth having an axial vascular connective tissue strand. Only this basal part persists, and passes into the formation of Lieberkühn's glands; the rest undergoes disruption. In other mammals there is no real degeneration or disruption, though the villi are used up in forming the glands.

What is "Anlage"? ‖—Mr. Arthur Willey suggests that the indispensable word "Anlage" might be conveniently rendered "*primordium.*" "Forecast" is inadequate, "fundament" is unsightly, and "rudiment" is inaccurate, for the rudiment is the middle, not the initial stage in organogeny. "As the organs of the animal body are built up of tissues, and these of cells, so, in their development, they spring from rudiments, and these from 'Anlagen'"—or primordia.

* 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, &c., 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 and Reproduction, and allied subjects.

‡ Biol. Centralbl., xviii. (1898) pp. 552–7 (10 figs.).

§ Verh. Phys. Med. Ges. Würzburg, xxxii. (1898) pp. 1–9 (1 pl.).

‖ Nature, lviii. (1898) p. 390.

Artificially produced Cauda bifida.*—Herr D. Barfurth points out that the *spina bifida* and *cauda bifida* which have been often produced artificially are rather due to imperfect coalescence (*asyntaxia medullaris* and *asyntaxia caudalis*) than to a literal bifurcation. But the latter does occur in nature in *Lacerta*, *Varanus*, *Petromyzon Planeri*, &c., and he has been able to produce it artificially in tadpoles of *Rana fusca*, by wounding them with a blunt hot needle in the mid-dorsal line of the median portion of the tail, and then amputating the posterior portion. The result in many cases is that from *two* regeneration centres a bifid tail grows out.

Fœtal Development of the Glomus coccygeum.†—Herr J. H. Jakobsson finds that this structure (so-called *Steissdrüse*) appears in a human fœtus of 15 cm. in length (end of fourth month) as an oval clump of epithelium-like cells bounded by a capsule of connective tissue strands, and connected by numerous fibres with the sympathetic. Later on, connective tissue predominates in the organ, which also becomes very vascular and lobulated. But its origin is certainly not in the connective tissue, nor from medullary canal, notochord, or rectum. It is in all probability derived from the end of the sympathetic, with which it is from the first closely connected.

Share of the Ectoderm in Forming the Pronephric Duct.—Prof. van Wijhe ‡ reaffirms the conclusion which he reached some years ago, that the ectoderm shares in the development of the pronephric duct of Selachians (*Scyllium*, *Raja*, &c.)—a conclusion from which Rabl, who once agreed, has since vigorously dissented. Van Wijhe's conclusion rests upon two facts: the coalescence of the caudal end of the growing duct with the epidermis, and the position of the dividing nuclei, which are so disposed that one daughter-nucleus must go to the "*Anlage*" (primordium) of the duct, while the other remains in the epidermis.

Miss E. R. Gregory § has also observed in embryos of *Acanthias*, that when the pronephric duct begins to grow backwards, there is a coalescence between its end and the ectoderm.

Sex in a Brood of Sparrow-hawks.‖—Dr. R. W. Schufeldt found that in a brood of five young sparrow-hawks examined by him, the sexes of the nestlings alternated regularly, the oldest being a male, the next a female, and so on. From the relative sizes of the birds he inferred that the eggs had been laid at regular intervals, probably of three or four days, and that incubation had begun as soon as the first egg was laid. He makes no suggestion as to the interpretation of the alternation of sex.

Syncytia in Development.¶—Prof. W. His publishes a very important paper on syncytia, that is, "complexes of mutually connected histological units or plasmochores, which are distinctly separated from

* Verh. Anat. Ges. xii. Vers., in Anat. Anzeig., xiv. Erg.-hft. (1898) pp. 24–6.
† Arch. Mikr. Anat., liii. (1898) pp. 78–106 (2 pls.).
‡ Verh. Anat. Ges. xii. Vers., in Anat. Anzeig., xiv. Erg.-hft. (1898) pp. 31–7 (7 figs.).
§ Zool. Bull., i. (1897) pp. 123–9 (8 figs.). See Biol. Centralbl., v. (1898) pp. 817–8.
‖ Amer. Nat., xxxii. (1898) pp. 567–70 (1 fig.).
¶ Abhandl. k. Sächs. Ges. Wiss, xxiv. (1898) pp. 401–68 (41 figs.).

one another by limiting areas or diastemas." Their primary origin is from incomplete processes of division; but they may also arise secondarily by the marginal coalescence of previously distinct cells. Both types occur abundantly in the blastoderm of fishes. The author maintains that syncytia, pluripolar nuclear division, and giant-nuclei or syncaryoses, are associated phenomena implying intense plasmic activity and favourable nutritive conditions. The paper is beautifully illustrated.

Effect of Gases on Development.*—Herr P. Samassa finds that hydrogen has a much more deleterious influence on frogs' ova than nitrogen has. In pure oxygen the development was normal for the first four days; in the absence of oxygen it also proceeded normally for some time. The ova of *Ascaris megalocephala* can survive being kept for months without oxygen, but in hydrogen or nitrogen they died. Pure oxygen greatly inhibited development of the *Ascaris*-eggs; at a pressure of 2½ atmospheres of pure oxygen, development stopped, and the eggs were all dead on or before the eleventh day.

Spiral Fibre of Mammalian Spermatozoon.†—Herr C. Benda now agrees with A. von Brunn that the spiral thread round the connecting or middle piece of the spermatozoon is formed by the apposition of protoplasmic granules. These are not, however, ordinary components of the plasm, but new, and probably of some specific function.

Theory of Biogenesis.‡—In the second volume of his work on the cell and the tissues, Prof. O. Hertwig expounds afresh his theory of development. There are two sets of factors:—(*a*) external or environmental, including the interactions of the cells amongst themselves; (*b*) internal or inherent in the hereditary idioplasm. There are two substances which together make up the living substance:—(1) the idioplasm, which conserves the hereditary characters of the species, though it is at the same time modifiable by external influences; and (2) a formed plasm or *Protoplasma-product*, which is moulded by the idioplasm. Inclining to a Lamarckian position, the author holds that the idioplasm is modifiable from without, and that lines of development and evolution are thus in part determined from without.

Derivatives of the Visceral Clefts in the Lizard.§—Herr F. Maurer notes that in Vertebrates with permanently open clefts, the derivatives are the thyroid, the thymus (from the dorsal pouches of clefts 2–4), and the post-branchial bodies behind the last cleft. When pulmonary respiration begins, there are additional derivatives of the clefts, namely, the epithelial corpuscles and the carotid glands of Urodela, and besides these, in Anura, various residues of the internal gills. He proceeds to inquire into the state of affairs in *Lacerta agilis*.

The primordium of the thyroid is formed as in fishes and amphibians. The post-branchial bodies appear, sometimes on the left only, sometimes on both sides, close behind the last cleft. The thymus primordia are

* Verh. Nat. Med. Ver. Heidelberg, vi. (1898) pp. 1–16.
† Verh. Anat. Ges. xii. Vers., in Anat. Anzeig., xiv. (1898) Erg.-hft., pp. 264–6.
‡ 'Die Zelle u. die Gewebe. Zweites Buch. Allgemeine Anatomie und Physiologie der Gewebe,' Jena, 1898.
§ Verh. Anat. Ges. xii. Vers., in Anat. Anzeig., xiv. (1898) Erg.-hft., pp. 256–61.

formed from the second and third clefts, and the details of the development show a condition similar to that in Ichthyopsida, but also pointing forward to mammals. From the ventral thymus-mass of the third cleft the carotid gland is separated off, and seems to be homologous with the anterior epithelial corpuscle of amphibians.

The anterior thymus of the lizard corresponds to the thymus of the second cleft in Ichthyopsida; the posterior thymus of the lizard in its dorsal portion corresponds to the thymus of the third cleft in Ichthyopsida; but the ventral part is new. In mammals the thymus arises wholly from the third cleft, and is wholly ventral. From the fourth cleft in the lizard no dorsal thymus arises, but there is a transitory epithelial body.

Early Development of Salamander.*—Herr Grönroos has convinced himself that in *Salamandra maculosa* the ectoderm cells of the lower half of the egg arise *in loco* from the coarsely granular yolk-laden cells, or in other words, are derivatives of the original macromeres.

The Marsupial Larynx.†—Prof. Johnson Symington describes the marsupial larynx, contrasting it with the larynx of higher mammals. In pouch specimens there is not only a well marked intra-narial glottis, but also a distinct *arcus palato-pharyngeus*, consisting mainly of a fold of mucous membrane, with only a thin sheet of muscular fibres between its two layers. These fibres do not form a distinct sphincter, but the naso-pharynx is closed during deglutition by mechanical means, the wall of the arcus being pressed by the food against the wall of the larynx. An obvious peculiarity of the marsupial larynx is the fusion anteriorly of the cricoid and thyroid cartilages, a union which the author regards as a secondary process. With regard to the true vocal cords, these are small and not readily distinguishable in many marsupials, but in pouch-specimens of *Macropus bennetti* they are well developed, and that of the adult *Macropus* must be regarded as degenerate. Prof. Symington points out the interest of this in connection with the voicelessness of marsupials, and suggests that they may be descended from a stock with a voice.

Spermatogenesis of Dog-Fish.‡—Herr B. Rawitz describes the division of testicular cells and the spermatogenesis in *Scyllium canicula*, with the particular end in view of discovering, by comparative studies, the general role of the attraction-sphere. He describes the processes of division concerned in the origin of the spermatocytes of the first and of the second order. Between the two there is a resting period, during which part of the chromatin-substance is reduced in amount, but there is no reduction-division in Selachians. After discussing the role of the attraction-sphere, and showing that it arises in the spermatids from the central spindle of the preceding stage, he passes to the development of the spermatozoa, and shows that the middle portion arises from the attraction-sphere of the spermatid.

Heteropagous Monstrosities.§—Dr. L. Cerf describes the rare human monstrosity known as heteropagy, of which only four cases have previ-

* Verh. Anat. Ges. xii. Vers., in Anat. Anzeig., xiv. (1898) Erg.-hft., pp. 261–4.
† Journ. Anat. Physiol., xxxiii. (1898) pp. 31–49 (8 figs.).
‡ Arch. Mikr. Anat., liii. (1898) pp. 19–62 (1 pl.).
§ Journ. Anat. Physiol., xxxiv. (1898) pp. 706–19 (2 pls.).

ously been recorded. It is a form of double monstrosity, in which one of the two individuals is parasitic on the other, and in which the parasite has a distinct head, and at least rudimentary pelvic limbs. He discusses the various theories as to such phenomena, and inclines to believe that the two forms result from one ovum with two nuclei, of which one has been fertilised, while the other has developed parthenogenetically.

Structure and Development of the Vertebrate Brain.*—Prof. B. Haller has made a detailed study of the brains of *Salmo* and *Scyllium*, and discusses the Vertebrate brain in general. We cannot attempt to summarise his results, which extend over nearly three hundred pages, but we may give a hint as to his speculative conclusion, which cannot be said to lack solid basis. The primitive form of the Chordata (the Helminth) had as a central nervous system a pair of supra-œsophageal ganglia and lateral nerve-cords. The two cords approached one another dorsally and coalesced in a single dorsal cord. Their former separateness remained only in the central canal, which was continued on to the primitive brain, where a similar cavity arose by a coalescence of the ventral parts of the ganglia. The two cavities communicated directly. Thereafter began a metameric differentiation of the nerves, both cerebral and spinal. On the pre-chordal brain, the formation of the Vertebrate paired eyes began the process of cerebral differentiation to which the subsequent concentration of the olfactory spheres gave a further impulse.

b. Histology.

Experimental Cytology.†—Dr. A. Labbé has done a useful piece of work in preparing a handy introduction to experimental cytology. It sums up the chief results of recent work on microscopic foams, the influence of environment on cell-structure and metabolism, the inter-relations of nucleus and cytoplasm, the various "tropisms" and "tactisms," and so on. There is not a great deal about any one subject, but there is a little about many subjects, and all is clear and accurate.

Formation of Blood-corpuscles in the Lamprey.‡—Sig. M. Ascoli finds that in the lamprey the production of both the white blood-corpuscles and the red blood-corpuscles takes place by the mitoses of corresponding young stages of these. The mitosis of the leucocytes was observed both in the circulation and in the lymphoid tissue of the spiral valve and kidneys, while the mitosis of the red blood-corpuscles was observed only in the circulation.

Eosinophilous Granulations of Leucocytes.§—Dr. N. Bogdanoff supports the view, that just as the chromatin substance of the nucleus may form in whole or in part "hæmoglobinogen" substance in the red blood-corpuscles, so it may be transformed into eosinophilous granulations, and then into fat in the leucocytes.

Post-Embryonal History of Striped Muscle-fibres.‖—Mr. A. Meek has sought an answer to the question whether the fibres are added to

* Morphol. Jahrb., xxvi. (1898) pp. 345-641 (11 pls. and 23 figs.).

† 'La Cytologie expérimentale. Essai de cytomécanique,' Paris, 1898, 8vo, viii. and 187 pp., 56 figs.

‡ Atti Accad. Sci. Torino, xxxiii. (1898) pp. 916-23.

§ Physiol. Russe, i. (1898) pp. 35-43 (2 pls.).

‖ Anat. Anzeig., xiv. (1898) pp. 619-21.

after birth, or whether they simply hypertrophy. In the field mouse, the cat, and the tame rat, hypertrophy of the fibres occurs, accompanied by a reduction in their number, "hypertrophy accompanied by aplasia." There is in fact a struggle and a survival of the fittest. The paper is an interesting concrete illustration of the idea of intra-organismal struggle with which Roux and others have made us familiar.

Cuticular Structure.*—Herr A. Wolff finds fine parallel striation in the cuticle of the epithelium of the snail's horns and of the tail of larval salamanders. In such places it is impossible to think of digestive or absorptive (?) function, as is suggested in connection with the cuticular striation of intestinal epithelium. This makes it doubtful whether, in the last-named case, it has anything to do with the passage of emulsified fat.

Origin of Epithelial Tissue.†—MM. A. Sabatier and E. de Rouville maintain that the epithelium finds a very active auxiliary in the subjacent connective tissue. A connective tissue cell may become epithelial; in fact the connective tissue acts like a post-embryonic blastoderm, and may give origin to endodermic as well as ectodermic epithelium. Amitosis is a simple and rapid mode of division exhibited by elements which have a maximum of vitality.

Direct Division.‡—Dr. W. Karpow has studied this in the tracheal epithelium of the cockchafer, in the chorion of mammals, and in the epidermis of the frog, and regards it as due, in part, to the vegetative growth of the nucleus, and, in part, to mechanical conditions of pressure.

Inter-Renal Body of Selachians.§—Dr. A. Kohn has studied this body in Selachians and in its relation with similar structures in other Vertebrates. It is an unpaired body, situated dorsally between the caudal portions of the kidneys. Its nature is epithelial, and it consists of ramified cellular strands, between which there are thin-walled blood-vessels. Fat globules in the epithelial cells give the organ its yellow colour. The supra-renal bodies are quite different, representing portions of the sympathetic ganglia, and containing, besides a few of the typical elements of these, a predominance of "chromaffine cells." But though the inter-renals (*Nebenniere*) of Vertebrates are essentially epithelial, they contain, from Amphibians onwards, an increasing amount of sympathetic tissue with all its elements. They have no typical glandular character nor epithelial ducts, and may be compared to the epithelial bodies in the vicinity of the thyroid.

Path of the Spermatozoa from the Testis of Frogs.‖—Dr. H. Beissner has reinvestigated this subject, in regard to which previous observations are very discrepant. In *Rana fusca* the spermatozoa pass from the testis through the vasa efferentia, which traverse the mesorchium, and unite on the median margin of the kidney with Bidder's longitudinal canal, whence they pass onwards through the ampullæ and transverse canals into the ureter. But in *R. esculenta* the path is

* Anat. Anzeig., xv. (1898) pp. 148–51.
† Comptes Rendus, cxxvii. (1898) pp. 704–6.
‡ Ann. Inst. Econ. Rurale Moscou, v. (1897). See Physiol. Russe, i. (1898) p. 112.
§ Arch. Mikr. Anat., liii. (1898) pp. 281–312 (1 pl.).
‖ Tom. cit., pp. 168–79 (1 pl. and 2 figs.).

different. The spermatozoa pass into Bidder's longitudinal canal, which gives off on the ventral surface of the kidney transverse canals leading through the parenchyma. From these the spermatozoa pass by simple or branched tubules into several Malpighian bodies, and thence by the associated urinary tubules into the efferent transverse canals, and thus into the ureter.

Ganglion-cells of Rat's Heart.*—Dr. S. Schwartz states that ganglion-cells are found only on a limited area of the posterior auricular wall, more to the left than to the right of the septum. They occur as four or five large groups, and a few isolated cells between, and lie between the visceral pericardium and the myocardium, surrounded and traversed by connective tissue. Besides the ganglion-cells there are on the surface of the heart numerous granular cells (Ehrlich's *Mastzellen*), but there is no reason to regard these as ganglionic.

Changes in the Dendrites in Intoxication.†—Dr. S. Soukhanoff finds that the moniliform state of the dendrites is not appreciably increased in the guinea-pig placed under the influence of ether, chloroform, or alcohol. But intoxication with trional brings about a "pearled" state in almost all the dendrites of the cerebral cortex. The pyriform appendages disappear more or less completely, and a moniliform state is more or less accented. The trional affects the general nutrition, as marked by considerable loss of weight; and it is suggested that the moniliform state may be an atrophic degeneration. It is also induced by arsenic, thyroidectomy, &c., which disturb the nutritive processes.

c. General.

Mechanical Explanation of Life.‡—Dr. Angelo Andres, well known for his beautiful work on sea-anemones, has published an interesting essay on the mechanical interpretation of life. Beginning with an eloquent passage on the "marvellous manifestations of life," he suggests the naturalness of assuming a special vital force, and shows why this hypothesis appears to him illegitimate. A discussion of the physico-chemical characters of living matter follows, in which the impossibility of absolutely distinguishing this from inorganic matter is shown; and then the author falls back upon one of the forms of monism which predicates the potentiality of consciousness as a fundamental property of matter. But has it not all been said many times before?

Atavism.§—Dr. J. H. F. Kohlbrugge has criticised the conception of atavism. He distinguishes:—(*a*) regularly occurring transitory palingenetic embryonic features, and regularly occurring rudimentary organs; (*b*) cases of arrested or inhibited development; and (*c*) the alleged cases of atavism. So-called atavistic characters arise irregularly, without obvious ontogenetic condition. There may be resemblance to ancestral forms, but this is not an expression of inheritance, merely of variation. "The doctrine of atavism (in the evolutionist sense) is not

* Arch. Mikr. Anat., liii. (1898) pp. 63–77 (1 pl.).
† La Cellule, xiv. (1898) pp. 387–95 (1 fig.), 399–415 (5 figs.).
‡ Ex Rivista Ital. Filosofia, May–June, 1898, 31 pp.
§ 'Der Atavismus,' Utrecht, 1897. See review by E. Wasmann, Biol. Centralbl., xviii. (1898) pp. 878–9.

based on facts." Neutral variations occur, and there is sometimes a resemblance due to coincidence rather than to inheritance. This sounds like proving too much; but we have not seen the original.

Inheritance of Immunity.*—Dr. A. Reibmayr has published an interesting essay on the evolution of immunity in the course of natural selection. Morbid conditions and tendencies are inherited, but so is immunity; and in the struggle between these the all-important factor is that the conditions of function and environment do not abet the morbid inheritance. There seems some evidence that females are more important than males in conserving and transmitting the immunity.

Variations and Races of the Mackerel.†—Mr. W. Garstang has investigated the various races and migrations of the mackerel (*Scomber scomber*), and concludes that those which frequent British waters are not exactly alike in all localities, but possess certain average peculiarities which distinguish one local race from another, as is shown in elaborate detail. The peculiarities are greatest between the races of localities which are geographically remote, and least between those which occupy areas that are geographically contiguous. Between the mackerel of the North Sea and those of the English Channel there are no differences at all; but the Irish race is distinctly divisible into two stocks, one of which is restricted to the west coast, the other to the south. A considerable amount of mixture takes place between the southern Irish stock and the fish which frequent the mouth of the English Channel. The western Irish stock represents more closely than any other race the primitive type of mackerel, from which all, whether British or American, have been derived.

Respiration in Cyclostomes.‡—E. Couvreur publishes the results of his study of the mechanism of respiration in young lampreys in the Ammocœte stage. The respiratory movements occur normally at the rate of about eighty a minute, but may rise to a hundred in excitement, or may be entirely suspended for a considerable time. During inspiration the lingual piston is projected forwards, thus opening the orifices to the respiratory tube (oscula); the walls of the body are expanded in the branchial regions, and the sphincters of the openings to the exterior are relaxed. Water then enters the branchial sacs by the oscula and spiracula simultaneously. During expiration the piston is retracted, and water flows out only by the spiracula, which are slightly open. When the lamprey is fixed, it both inspires and expires through the spiracles alone. Couvreur finds that the synchronism between the respiratory movements and the contractions of the heart recently discovered in Teleosteans obtains also in the lamprey, the projection of the piston corresponding to the systole, its retraction to the diastole of the heart.

Retrospect.§—Prof. A. S. Packard, as chairman of the zoological section of the American Association for the Advancement of Science,

* 'Die Immunisirung der Familien bei erblichen Krankheiten,' Leipzig und Wien, 1899 (published 1898), 8vo, 51 pp.

† Journ. Mar. Biol. Ass., v. (1898) pp. 235–95.

‡ Ann. Soc. Linn. Lyon, xliv. (1898) pp. 105–9 (2 figs.).

§ Proc. Amer. Ass. Adv. Sci., xlvii. (1898) 48 pp.

took for his subject 'A Half-century of Evolution, with special reference to the effects of geological changes on animal life.' He discussed the various biological movements of the Darwinian era, and summed up the present state of evolution theory. The second part of the address contains an interesting and valuable discussion of the geological causes of variation and elimination throughout the ages.

Evolution of the Warm-blooded Animal.* — Mr. H. M. Vernon points out that it is now possible to trace with more or less completeness the various stages by which the lower Invertebrates may have been gradually evolved, in a physiological sense, to produce a warm-blooded animal, such as man, in which the nervous system appears to possess almost perfect power of keeping the temperature of the body constant.

All cold-blooded animals are not alike in their reaction to temperature; in them, too, may be traced a gradual evolution of the nervous control of tissue metabolism, and even a gradual evolution in the reaction of tissue-change to temperature in respect of the tissues themselves, apart from a special nervous controlling influence. The author shows that the respiratory activity of a series of marine animals—from ctenophore to fish—is not by any means equally affected by equal variations in temperature. With evolution of structural differentiation, there would appear to be a gradual evolution of increased power of resistance to variations of temperature; but perhaps this is rather due to a gradual increase in the percentage of solids in the tissues of the organism.

In many cases the respiratory activity appears to increase regularly with the temperature, and there is no evidence that the nervous system has any special power of influencing the metabolism; but this cannot be generalised; since in other cold-blooded animals—earthworms, amphibians, &c.—the carbonic acid output does not increase regularly with increase of temperature. There exist temperature intervals over which the metabolism either remains constant or varies but slightly. Experiments made on frogs and toads cut through the medulla show that this want of dependence of metabolism on temperature must be ascribed to a direct control of the nervous system over the respiratory activity of the tissues.. It is noticeable that the intervals of constant metabolism more or less cover such variations of temperature as the animals would be ordinarily exposed to under normal conditions, except in the extreme cold of winter and extreme heat of summer.

Since, then, various cold-blooded animals have the nervous system sufficiently cooled to exert a controlling power over the tissue metabolism, the only other conditions necessary to convert these into warm-blooded animals of even temperature would appear to be an increased heat production by the tissues, coupled with a modification of the external covering of the body so as to diminish the heat loss. In some cases —bonito, python, lizard—it has been shown that the body temperature may be raised considerably above the external temperature.

The author then considers Sutherland's interesting observations on the variable temperature of monotremes and marsupials.

The next step in the argument relates to the true placental mammals. "It is generally stated that warm-blooded animals differ from the cold-

* Science Progress, vii. (1898) pp. 378–94.

blooded in exhibiting an increased respiratory activity at low temperatures and a diminished one at high temperatures, and also that the nervous system is able to regulate the heat production and heat loss so efficiently that the body temperature is practically uninfluenced by that of its surroundings." But under certain conditions, e. g. in man and hibernating mammals, both of these relations are departed from, and thereby a connection with the cold-blooded animals is established.

In conclusion the author refers to three interesting points:—(1) that in birds there seems to be a gradual rise of temperature accompanying the increasing complexity of morphological structure; (2) that in birds there is an apparent interdependence of size and body temperature; and (3) that there is in some measure a physiological recapitulation, inasmuch as the embryonic warm-blooded animals (unhatched chick, newly born rats and mice, &c.) which have descended from a cold-blooded ancestor are themselves cold-blooded.

Whip-Snakes.*—Mr. Frank Finn is able, from his own experience, to testify to the correctness of the popular belief that the whip-snake strikes deliberately at the eye. He held two specimens in his hand, and the larger of the two first bit his hand, and then struck out suddenly at his eye. He closed it instinctively, and so escaped with a couple of bites in the upper and one in the lower eyelid. A tooth—not a grooved one, however—was left in the wound, but no unpleasant results ensued.

Living Organism.†—Mr. Alfred Earl has made a critical study of biological categories which may serve as a timely protest against the too prevalent easy-going fashion of dealing with such big problems as are covered by the words "organism," "species," "protoplasm," and the like. The keynote of the book is "the unity of the organism," which remains a secret fact, but the author has much that is suggestive and forcible to say in regard to concrete problems. We must, however, content ourselves with quoting the last sentence of the preface:—"The object of the book will be attained if it succeeds, although it may be chiefly by negative criticism, in directing attention to the important truth, that though chemical and physical changes enter largely into the composition of vital activity, there is much in the living organism that is outside the range of these operations."

Tunicata.

Life of a Tunicate Colony.‡—M. Antoine Pizon describes the remarkable succession of generations in a colony of *Botrylloides rubrum*. Between the first of February and the fifteenth of May there were seven generations, none sexual. Each had only about a week of adult life, and then fell victim to rapid degeneration. A striking fact is the vitality of the heart, which continues beating even when the ascidiozoid has degenerated into a small granular mass. The persistence of contractions ensures the distribution of the mass of degenerated material to the vessels of the colony. Within a colony all the hearts contract simultaneously, and, at a given moment, all in the same direction.

* Journ. Asiat. Soc. Bengal, lxvii. (1898) pp. 66–7.
† 'The Living Organism. An introduction to the problems of biology,' London, Macmillan and Co., 1898, 8vo, xiii. and 271 pp.
‡ Comptes Rendus, cxxvii. (1898) pp. 127–30.

INVERTEBRATA.

Chlorophylloid Pigments.*—Miss M. I. Newbigin gives an account of her observations on chætopterin, "enterochlorophyll," bonellin, and other green pigments in Invertebrates. She describes the various reactions of chætopterin, and notes as points of special importance that while chætopterin itself is indefinite in colour and strongly fluorescent, and exhibits a complex spectrum, the action of reagents tends to produce pigments of bright definite tint and simple spectrum, which may be soluble in water and are without fluorescence. Certain points of resemblance to bonellin are also of much interest.

Enterochlorophyll from Molluscs and Echinoderms is closely related to chætopterin, but differs a little in spectrum, colour, and solubility. It has an apparent resemblance to plant chlorophyll in fluorescence, in its association with a yellow lipochrome, and in its spectrum; but its resemblance to chætopterin tends to disprove its identity with the plant pigment. The balance of evidence is in favour of an affinity between bonellin, chætopterin, and enterochlorophyll. "It is interesting to note that in many groups of Invertebrates, either in the same animal or in related forms, there may occur two different sets of green pigments, distinctly marked off from one another, but connected by the derivatives of the more complex series. Such are bonellin and thalassemin in the Echiuridæ, chætopterin and the pigment of *Eulalia* in the Chætopoda, enterochlorophyll and the pigment of *Acmæa* in the Mollusca; it is probable that there are many other cases."

It seems then that there exists in Invertebrates a widely spread group of pigments occurring primarily in connection with the alimentary tract or its outgrowths, and characterised by forming in alcohol fluorescent solutions of indefinite colour which exhibit a complex spectrum, consisting when fully developed of five bands. They have only a superficial resemblance to chlorophyll, and they so far resemble the bile pigments of Vertebrates that they occur mingled with the contents of the gut, and at least in some cases are eliminated with the fæces. Of their primary function nothing is really known. As a general designation the term "enterochrome" or "polychrome" is suggested.

Nervous System of Invertebrates.†—Herr J. Steiner has extended his study of the central nervous system to Invertebrates. He has defined the brain as the general motor centre in connection with at least one of the higher sensory nerves, and his object has been to determine experimentally what parts can be physiologically called a brain in the Invertebrates. This is shown to be the case with the supra-œsophageal ganglion of Crustacea and Tracheata, but not of Annelids, whose dorsal ganglion is a sensory but not a motor centre. Similarly in Nemertines and Planarians the dorsal ganglion is a sensory centre. In Molluscs the term brain is inapplicable, but the dorsal ganglion of *Octopus* (without which the animal does not feed itself or move voluntarily) is comparable to the Vertebrate cerebrum. In Appendiculariæ, Echinoderma, and Cœlentera, there is no part that can be called a brain. The cerebrum of *Octopus*

* Quart. Journ. Micr. Sci., xli. (1898) pp. 391–431 (2 pls.).

† 'Die Funktionen des Centralnervensystem und ihre Phylogenese,' iii. Abth., Braunschweig, 1898. See Biol. Centralbl., xviii. (1898) pp. 749–51.

has probably arisen from an optic centre, that of Vertebrates from an olfactory centre.

Mollusca.

α. Cephalopoda.

Chromatophores of Cuttlefishes.*—Herr B. Solger maintains that the chromatophore proper is a single cell which by its own metabolism forms pigment, and that the surrounding cells form an elastic capsule, or that and radial muscular cells as well. He has shown by the methylene-blue method that nerves do really end in the radial cells, and is firmly convinced that these are muscular elements.

γ. Gastropoda.

Anal Kidney of Larval Opisthobranchs.†—Dr. G. Mazzarelli, against Meisenheimer, Heymons, and others, vindicates his previously expressed conclusion that this organ (the "anal-eye" of Lacaze-Duthiers and Pruvot) is of ectodermic origin, and persists in the free-living larvæ of *Aplysia*, &c., after its closure. It does not disappear, as has been stated, and is a definitive, not a primitive kidney.

δ. Lamellibranchiata.

Pigment-formation in Lamellibranchs.‡—Herr Victor Faussek has made an extended series of observations on the conditions necessary for the formation of pigment in the mantle, gills, and foot of Lamellibranchs, especially *Mytilus*. His results lead him to reject entirely Ryder's view that light is the most important factor. Numerous observations with uninjured specimens, and with specimens deprived of the whole or part of the right valve, failed to show that light has any influence whatever; while the connection between the depth of pigmentation in any part of the body and the degree of oxygenation of the water washing this region, is marked. The author succeeded in so adjusting specimens that the incoming current of water washed the anterior part of the mantle before reaching its posterior region, and found that this hitherto unspecialised and colourless region rapidly developed the peculiarities of colour and structure normally found only in the posterior region. The pigment is especially marked if the two regions of the mantle be separated by a deep cleft, a fact which, taken in conjunction with others, leads the author to believe that the formation of pigment in Lamellibranchs is due to the action of oxygen on a chromogen contained in the blood. Under normal conditions, therefore, pigment formation will occur only in organs freely exposed to the inhalant current, and the pigmentation will be most intense in that part of any organ which first receives the oxygenated water; hence the tendency for pigment to accumulate in the posterior region of the mantle in most Lamellibranchs.

Artificial Production of Pearls.§—M. Louis Boutan describes a series of experiments made by him with a view to the artificial production of pearls. Choosing *Haliotis* as the subject of his experiments,

* Arch. Mikr. Anat. liii. (1898) pp. 1-19 (1 pl.).
† Biol. Centralbl. xviii. (1898) pp. 767-74.
‡ Zeitschr. f. wiss. Zool lxv. (1898) pp. 112-42 (3 figs.).
§ Comptes Rendus, cxxvii. (1898) pp. 828-30.

because of its ready acclimatisation and its comparatively great power of resistance to the effects even of severe operations, M. Boutan "trepanned" the shells, and introduced minute beads of mother-of-pearl through the openings, which he afterwards closed with cement. The beads were so placed as to lie between the mantle and the shell, and in all cases mother-of-pearl was secreted over their surface. From many of the shells really fine pearls were procured. These, though the same in chemical composition as natural pearls, of course, have the desired orientation in circular layers only on the periphery, since they enclose a fairly large nucleus of foreign matter. But M. Boutan maintains that his pearls cannot on this account be called false, because even pearls which are naturally produced contain a nucleus of undetermined size.

Cephalic Eyes in Lamellibranchs.*—Dr. Paul Pelsener has found that a pair of distinct and well-developed cephalic eyes may occur in adult Mytilidæ. They are formed by little pits with pigmented walls and containing a cuticular lens, thus exhibiting a structure intermediate between the eyes of *Trochus* and those of *Patella*. They appear to be peculiar to the majority of the genera of the Mytilidæ (*Mytilus*, *Lithodomus*, *Modiolaria*), and to the allied genus *Avicula* properly so-called, that is, excluding *Meleagrina*. They occur in both larva and adult, but appear in the larva (*Mytilus*) only after the development of the first branchial filament. They are situated at the base and on the axial surface of the first filament of the internal branchial lamella, and are innervated from the cerebral centre. In the larva they lie *outside* of the posterior margin of the velum, and are therefore homologous with the larval eyes of Chitons, but not with the cephalic eyes of Gastropods, which arise within the velar area.

Arthropoda.

α. Insecta.

Colour-Evolution in the Pieridæ.†—Herr M. C. Piepers publishes an elaborate paper on this subject. He believes that the most primitive colour in the wing-scales of the Pieridæ is red, and that colour changes take place along a definite line, influenced, but not determined, by external conditions. The course of evolution is such that the primitive red tends to fade to orange, yellow, and ultimately white, while simultaneously there is a development of brown or black colour, the amount of black varying inversely with the amount of red. During these stages the females may lead the way in colour change (female preponderance); but as a further stage the black may disappear, and the white greatly increase in amount, and in this direction it is always the males which lead (male preponderance). Ultimately the white pigment may disappear, a process which is followed by the loss of the scales themselves. While these changes are occurring, there is a simultaneous development of structural colour, which is apparently the last stage in colour-evolution. The author seems disposed to regard these statements as true not only of the Pieridæ, but also of other butterflies, notably the Papilionidæ.

* Comptes Rendus, cxxvii. (1898) pp. 735–6.
† Tijdschr. Nederland. Dierkund. Ver., v. (1898) pp. 70–289.

He also thinks that a hypothesis of this kind sheds much light upon such phenomena as seasonal and sexual dimorphism, natural and artificial colour variation, the development of local races, and the similar colour phenomena of Lepidoptera, which are all to be explained as showing that butterflies are, from internal causes, constantly varying in colour in a definite direction, and that special stages in evolution may be emphasised by particular, usually external, influences.

Coloration of Insects.*—Herr T. Garbowski briefly criticises Brunner von Wattenwyl's volume on this subject. From the philosophical point of view he maintains that the result of Brunner's reasoning is to suggest that the coloration of insects has no relation to the needs or structure of the organism, but is merely an expression of the Supreme Will. By a series of concrete examples, Garbowski further endeavours to show that Brunner's results are inconsistent with the facts as known to entomologists.

Development of Markings of Butterflies.†—Gräfin Maria von Linden has studied the wings in the pupæ of various butterflies, especially species of *Vanessa* and *Papilio*, in order to determine the question whether, in the ontogeny of the colour and markings, the characteristics of the adult develop slowly from primitive markings, or appear suddenly. The results show that, especially in the case of the less specialised species, there is in ontogeny a gradual development of the markings; and from this development hints as to the phylogenetic origin of the markings may be gathered. The author is of opinion that the course of development entirely supports Eimer's well known views in regard both to the origin of markings and patterns, and of species themselves. As to the development of colour, the first tint to appear is yellow, and there is then a gradual progression through orange, red, brown, to black. Optical colours, such as blue, appear later than the dark tints, and are confined to scales containing dark pigment.

Coloration of Lepidoptera.‡—Dr. M. Baer has investigated the structure of the wing-scales in the diurnal butterflies in its relation to the colours, and publishes a concise summary of his results. These are in the main similar to those of preceding observers, but are in some respects more detailed. He divides the colours into (1) those due only to pigment, (2) optical colours, (3) colours produced by the combination of pigment and structure. (1) Except in the Pieridæ, he finds that the pigments are uniformly diffused and not granular; and, like previous observers, he has found pigments of all tints except blue, violet, and intense black. Green and white pigments he finds to be rare, the former apparently occurring only in the wing membrane. In the Pieridæ the scales are few in number, often quite devoid of sculpture, and deeply pigmented with granular pigment. (2) The author's observations on optical colours entirely confirm those of Spuler. (3) Colours such as reddish-violet, greenish-blue, emerald-green, are produced by the superposition of scales containing bright pigment and scales exhibiting optical colours.

* Biol. Centralbl., xviii. (1898) pp. 456-8.
† Zeitschr. f. wiss. Zool., lxv. (1898) pp. 1-49.
‡ Tom. cit., pp. 50-64.

Sting of Ants.* —M. Charles Janet describes in Myrmicinæ an apparatus adapted to close the poison reservoir, and gives a detailed account of the mechanism of stinging.

Respiratory System of the Larvæ of Entomophagous Hymenoptera.†—L. G. Seurat has studied the disposition of the tracheæ in Braconidæ, Chalcididæ, and Ichneumonidæ, and finds that while the fundamental plan is the same throughout, there are minor differences which make it possible to establish distinctive characters between the larvæ of different families. This may be of service in the identification of larval forms, usually so difficult.

Alkaline Reaction of Ants' Nests.‡—M. Charles Janet points out that in the chambers and galleries of *Solenopsis fugax* and other ants the reaction is markedly alkaline. This is due to the secretion of the integumentary glands, the function of which may be to neutralise the acidity of the poisonous secretion. This is probably the special use of the accessory (alkaline) gland beside the poison-gland; it will serve to neutralise the small quantity of poison which may remain about the delicate and slightly chitinous region surrounding the sting and the anus.

In the same paper the ingenious author notes that workers of *Formica rufa* decapitated by him in his search for the *Rhabditis* parasitic in the head, survived in a moist chamber for several days,—three for two days, one for three, two for five, one for seven, two for nine, one for nineteen.

Structure of the Testis in Silk-Moth.§—Prof. A. Tichomirow describes the testis as consisting of connective tissue stroma and sperm-cells. The stroma forms (1) a sharply defined sheath to the testis, with three septa of looser connective tissue; and (2) a delicate network of connective tissue bridges which traverse the cavity of the chambers (intermediate tissue). At some places these bridges may become rich in plasma ("*stark plasmatisch*"); and this is always the case above each of the four chambers into which the testis is divided, thus giving rise to "Verson's cell." Later on, when the spermatocysts begin to mature, one of the connective tissue corpuscles of the cyst membrane undergoes a similar change, and assumes the role of Sertoli's cell.

Monograph on the Parasitic Larva of Thrixion Halidayanum.‖—J. Pantel describes at great length the external characters, the structure, and the habits of this rare larva parasitic in the females of *Leptynia hispanica*, one of the Orthoptera. The summary alone occupies over ten of the sumptuous pages of *La Cellule*.

New Parasite of Bats.¶—Herr P. Speiser describes *Polyctenes talpa* sp. n., the sixth species of this genus, from *Megaderma spasma*. The specific title refers to the mole-like outline of the head.

Wings of Insects.**—Messrs. J. H. Comstock and J. G. Needham conclude their discussion of the specialisation of insect wings by reduction

* Comptes Rendus, cxxvii. (1898) pp. 638–41 (15 figs.).
† Tom. cit., pp. 636–8. ‡ Tom. cit., pp. 130–3.
§ Zool. Anzeig., xxi. (1898) pp. 623–30 (5 figs.).
‖ La Cellule, xv. (1898) pp. 7–290 (6 pls.).
¶ Zool. Anzeig., xxi. (1898) pp. 613–5 (1 fig.).
** Amer. Nat., xxxii. (1898) pp. 561–5 (3 figs.). Cf. this Journal, 1898, p. 626.

in the venation, and will proceed to consider specialisation by addition. In dealing with the wings of Coleoptera in the present instalment, they conclude that elytra are modified wings, and find the strongest evidence in the very close correspondence which exists between the tracheation of the elytra and that of the hind-wings.

Regeneration in Phasmidæ.*—M. Edmond Bordage has shown that the regeneration of legs after artificial mutilation occurs only in the region of the tarsus and the lower third of the tibia; and he seeks to explain this limit as an adaptation related to the most probable breakages when the insects are attacked by lizards (*Calotes versicolor*), and when the larva is escaping from the egg-shell. Similarly, he ingeniously seeks to explain the fusion of the trochanter and femur in relation to the strains put upon this region in the process of ecdysis. The line of fusion, which he compares to ankylosis, forms a place of least resistance along which autotomy may most readily occur. What was a functional modification to start with has become a constitutional character, favoured by what the author somewhat quaintly terms "exuvial selection." Surely it is none the less natural selection because its *point d'appui* is in the process of exuviation.

Development of Chrysomelidæ.†—A. Lécaillon has studied *Clytra læviuscula*, *Gastrophysa raphani*, *Chrysomela mentastri*, *Lina populi*, *L. tremulæ*, and *Agelastica alni*. We cannot do more than state a few of his results. There seems to be no chitin in the envelopes of the ovum. The segmentation is typical, but intravitelline is a much better term for it than superficial or peripheral, since the nuclei are at first scattered in the vitellus. Most move to the periphery and form the ectoderm; those that remain internally form the endoderm. At this early stage the sex-cells are recognisable, apparently arising from the ectoderm. The mesoderm has an ectodermic and a very variable origin. Epithelial strands growing from the stomodæum and the proctodæum complete the gut, which is therefore wholly ectodermic. Indeed, in higher insects generally there is no endoderm in the adult, and in some cases (parasitic Hymenoptera) there is no rudiment of it even in the embryo. Thus the author is in close agreement with Heymons.

Mosquitoes and Malaria.‡—Prof. Grassi has published another preliminary note in support of his theory that various "mosquitoes" (*Anopheles claviger*, *Culex penicillaris*, and *Culex malariæ*) are agents in spreading malaria. He refers to the work of other writers who have suggested a connection between malaria and mosquitoes.

δ. Arachnida.

Oocytes of Pholcus.§—Prof. Ch. Van Bambeke gives a detailed account of his researches on the ovum of *Pholcus phalangioides* Fuessl. The first chapter discusses the origin and growth of the safraninophilous

* CR. Soc. Biol., July 1898, 6 pp.
† 'Recherches sur l'œuf et sur le développement embryonnaire de quelques Chrysomélides. Thèses présentées à la Faculté des Sciences de Paris,' Sér. A, No. 299 (1898) pp. 1–219 (4 pls. and 2 figs.). See Zool. Centralbl., v. (1898) pp. 813–6.
‡ Atti R. Acad. Lincei (Rend.), vii. (1898) pp. 234–40.
§ Arch. Biol., xv. (1898) pp. 511–98 (6 pls.).

vitelline body. The second chapter deals with its disintegration, and the associated changes in the nucleus and vitellus. Thirdly, the author describes the fatty degeneration of the elements which arise from the disintegration of the vitelline body. The fourth chapter is devoted to a description of the progressive vacuolisation of the vitellus, consequent on the appearance of vitelline spheres. Associated therewith is the establishment of a closer relation between vitellus and nucleus, and an increase in the surface of contact. Finally, the author examines all the views propounded as to the role of the vitelline body, and concludes that it is the centre of formation for the nutritive elements of the vitellus.

ε. Crustacea.

Dorsal Organs of Crustacean Embryos.* — Prof. J. Nusbaum and Herr W. Schreiber have studied these structures ("*Rückenorgane*") in *Mysis Lamournæ*, *Idotea tricuspidata*, and *Cymothoa œstroides*, and corroborate Wagner and Rossijskaja-Koschewnikowa as to the simultaneous occurrence of both dorsal and dorso-lateral organs, though they do not regard them as morphologically distinct. Both of these, and the inconstant accessory dorsal organs as well, are cœnogenetic structures which contribute to the reduction of the vitellocyte layer.

Vitality of Entomostraca.†—Mr. E. Atkinson relates that in 1858 he took some dried mud silvered over with minute shells of Entomostraca from the pool of Upper Gihon at Jerusalem. The pool contains water only during the two months of the rainy season, and Mr. Atkinson inferred that the ova of the crustaceans must live through the other ten months in the sun-baked mud. To test this, a quantity of the dry mud was sent home to England and moistened, and Dr. Baird, who examined the water, found in it six new species of living Entomostraca. During summer the water was entirely drawn off by means of a siphon, and the mud left undisturbed till the following spring, when fresh water was again added to it, with the same result as before. The experiment was repeated year after year by several observers, always with a like result. In one case, a portion of mud was moistened regularly until 1884, then left dry till 1894, when a fresh supply of water restored the annual activity, which is still maintained.

Entomostraca of Lake Bassenthwaite.‡—Miss E. M. Pratt gives an account of these as found at different seasons of the year. In an introductory note, Prof. S. J. Hickson reminds us how ignorant we are of the fauna of our own English lakes, and indicates that it might be practically worth while to study the relations between the fish-fauna and the Entomostracan fauna.

Entomostraca of Epping Forest.§—Mr. D. J. Scourfield has brought together the result of eight years' observations on the Entomostraca of the Epping Forest area. It appears that no less than 103 species have been seen in the district, comprising Cladocera 47, Branchiura 1, Ostracoda 23, and Copepoda 32. Three of these and one variety are considered to be new to the British fauna. As regards the periodicity of

* Biol. Centralbl., xviii. (1898) pp. 736–46 (4 figs.).
† Ann. Nat. Hist., ii. (1898) pp. 372–6.
‡ Tom. cit., pp. 467–76.
§ Essex Naturalist, x. (1898) pp. 193–210, 259–74, 313–34.

certain species, the facts previously obtained at Wanstead Park have been rather closely matched by the results from the whole district, as have also those relating to the seasonal distribution of the species in the different orders. Other points dealt with are the comparative abundance of the various species, the faunas of some well known forest ponds, and the occurrence of the males and "ephippial" females of the Cladocera. In connection with the last named subject, Mr. Scourfield thinks that his observations show that the influence of environment upon the production of the sexually mature individuals may be more direct than is admitted by Weismann. Prefaced to the actual results of the work on the local fauna, are some remarks on Entomostraca in general, which treat of such topics as the number of known species, their distribution, habits, reproduction, food, and economic importance, the methods of collecting, examining, and preserving, &c. The paper concludes with a very full bibliography of the literature relating to the British fresh-water Entomostraca.

A Very Common Water-flea.*—Mr. D. J. Scourfield, taking for his text a very common species, *Chydorus sphæricus*, has written a short paper which will probably be found useful as an introduction to the study of the Entomostraca, or at any rate to the smaller forms included in the family Lynceidæ. In addition to the descriptive remarks about the ordinary parthenogenetic female, special attention has also been given to the much rarer "ephippial" female and the male, and to the times and causes of their appearance.

Gigantic Fresh-water Ostracod.†—Herr G. O. Sars institutes a new genus, *Megalocypris*, between *Herpetocypris* and *Stenocypris*, for two new species (*M. princeps* and *M. hodgsoni*) from near Cape Town. In *Herpetocypris* and *Stenocypris* the females only are known, but the two sexes of *Megalocypris* seem to be almost equally numerous. The male of *M. princeps* was 6·5–7 mm. in length, the female 7·3 mm., while the largest European fresh-water Ostracods are scarcely half as long.

Burrowing Habit in Crustaceans.‡—M. Georges Bohn points out that the Homaridæ and Thalassinidæ exhibit a series of forms more or less adapted to burrowing, as is especially illustrated by the thoracic appendages. Beginning with *Homarus*, he shows the increasing adaptation in *Nephrops*, *Gebia*, and *Callianassa*; and notes that, apart from the adaptations in the thoracic appendages, there are other effects associated with the mode of life. Size decreases; there is less chitinisation and pigmentation; the branchiostegite is shorter; the gills are less developed; the exopodites of the maxillipedes become less functional. The Thalassinidæ may be considered as Homaridæ in which the burrowing habit has been followed by a relative arrest of development.

Stomatopod (?) Metanauplius Larva.§—Mr J. J. Lister describes a larval Crustacean (caught in a tow-net off the south coast of Tasmania), which presents some interesting features. It is in the metanauplius stage, and yet has well developed compound eyes. The articulated condition of the divisions of the caudal fork is also peculiar among the higher Crustacea; for the character of the eyes shows that the larva is

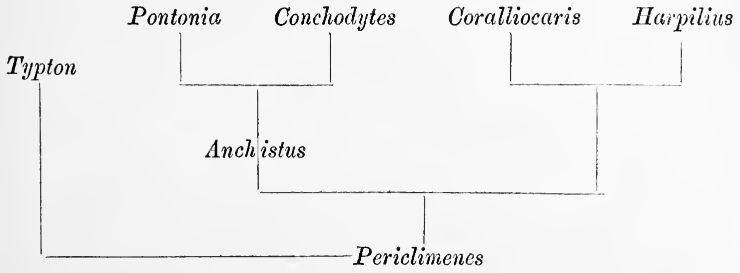
* Illustrated Annual of Microscopy, 1898, pp. 62–7 (1 pl.).
† Arch. Math. Naturvid., xx. (1898) 17 pp. (1 pl.). See Zool. Centralbl. v. (1898) p. 803.
‡ Comptes Rendus, cxxvii. (1898) pp. 781–3.
§ Quart. Journ. Micr. Sci., xli. (1898) pp. 433–7 (2 figs.).

Thoracostracan. It is probably a Stomatopod metanauplius, at a stage prior to the Ericthoidina stage.

New Parasitic Copepods.*—Staff-Surgeon P. W. Bassett-Smith continues his contributions to our knowledge of Copepods parasitic on fishes of the Indo-Tropic region. Some fishes, like species of *Caranx*, are very frequently and abundantly infected; others, such as Sparidæ, have rarely any parasites, the different character of the food perhaps causing the peculiarity. The author describes *Bomolochus megaceros* Hell.; *Caligus longipedis* sp. n. from *Caranx melamphigus*; *C. robustus* sp. n. from *Caranx* and *Thymus*; the male of *C. tenax*, not previously described; *Caligodes carangis* sp. n.; *Alebion carchariæ*, of which only a single example has hitherto been on record; the rare *Pseudocycnus appendiculatus* Hell.; *Lernanthropus nudus* sp. n. In this last genus the regular flushing and pallor of the laminate processes representing the third and fourth thoracic feet at every vascular contraction make it evident that Hesse was right in concluding that they act as branchiæ.

Revision of the Pontoniidæ.†—Mr. L. A. Borradaile discusses this family, which is included in the sub-tribe Monocarpinea, tribe Caridea, sub-order Macrura. The diagnosis is given as follows:—Monocarpinea with the body often depressed; rostrum not movable on carapace, often short, compressed or depressed, with or without dentations; outer flagellum of first antenna consisting of a thick hairy part, bearing a slender hairless part, the latter usually arising from the former at a short distance from the free end, and thus giving it a bifid appearance; mandible deeply cleft into two divisions, and always without a palp; endopodite of second maxilliped not biramous; third maxilliped pediform, but usually with some of the joints broadened; all the legs without exopodites or mastigobranchs; first two pairs of legs chelate, first pair slender, second pair larger than the first, not foliaceous. Mode of life often semi-parasitic.

The genera fall into four groups, whose relationships are illustrated by the following scheme.



North American Centropagidæ.‡—Mr. F. W. Schacht follows up his paper on the North American species of *Diaptomus* by another in which he treats of the three genera *Osphranticum*, *Limnocalanus*, and *Epischura*. Of these, *Osphranticum* containing only one species, and *Epischura* containing three, are, as far as is known, confined strictly to North

* Ann. Nat. Hist., ii. (1898) pp. 357–72 (3 pls.). † Tom. cit., pp. 376–91.
‡ Bull. Illinois Lab. Nat. Hist., v. (1898) pp. 225–69.

America, and are found only in fresh water, the first named usually in shallow or stagnant lakes and ponds, or in running water, the last in clear deep lakes. Of the two species of *Limnocalanus*, one, *L. sinensis*, occurs in China in fresh water only, the other, *L. macrurus* Sars, is known in America only in fresh water, but in Europe and Asia occurs both in fresh and salt water lakes, and in the ocean. Mr. Schacht discusses the structural similarities and differences indicative of the relationships of these three genera with one another and with *Diaptomus*. He regards *Osphranticum* as the most primitive form, *Epischura* as the most modified, while the other two occupy an intermediate position. Keys, and full descriptions of all the species are given.

Annulata.

Post-larval Stages of Arenicola.—M. Pierre Fauvel * brings forward further evidence in support of the conclusion which he maintained at the International Congress of Zoologists at Cambridge, that the genera *Clymenides* and *Branchiomaldane* represent post-larval stages of lobworms. Three stages are distinguishable:—(1) that represented by *Clymenides incertus* Mes. = *Arenicola* (*Branchiomaldane*) *Vincenti* Lgh.; (2) that represented by *Cly. sulfureus* Clp. = Benham's stage = *A. marina* L.; (3) *Cly. ecaudatus* Mes. = *Branchiomaldane* stage = *A. ecaudata* Jhnst. It remains to find the *Clymenides* and *Branchiomaldane* stages of *A. Grubii* Clp.

M. Félix Mesnil † maintains that *Arenicola branchialis* Aud. et Edw. (= *A. Grubii* Clp.) is quite distinct from *A. ecaudata* Jhnst. (= *A. Boeckii* Ratke); that *Clymenides ecaudatus* is the young abranchiate form of *A. ecaudata*; and that *Branchiomaldane Vincenti* is an adult hermaphrodite Annelid.

Nephridia of Glycera and Goniada.‡—Mr. E. S. Goodrich describes the "nephridial complex" in *Glycera convolutus*, *G. siphonostoma*, and *G. unicornis*. It consists of the nephridium, the closely associated ciliated organ, and a peculiar organ, the nephridial sac. The most remarkable point is the occurrence of peculiar nephridial cells bearing a tube and a flagellum, somewhat similar in structure to those which the author previously described in *Nephthys*. For these he proposes the term solenocyte. There seems to be no communication of the lumen of the nephridium with the cœlom, either directly or indirectly, through the nephridial sac, in any of the species of *Glycera*.

"It would appear that the ciliated organ and nephridial sac are concerned in the gathering up, through the agency of phagocytes, of the solid waste products found in the cœlom, whilst the function of the nephridium is to eliminate the soluble excretory material derived from the cœlomic fluid, and also perhaps from the sac. The function of the solenocytes or tube-bearing cells themselves is possibly analogous to that of the Malpighian capsules in the Vertebrates, namely to excrete liquid, which presumably can pass by osmosis through the thin wall of the tube."

The author also describes the nephridial complex of *Goniada emerita* and *G. maculata*, where, as in *Nephthys* and *Glycera*, the nephridium is

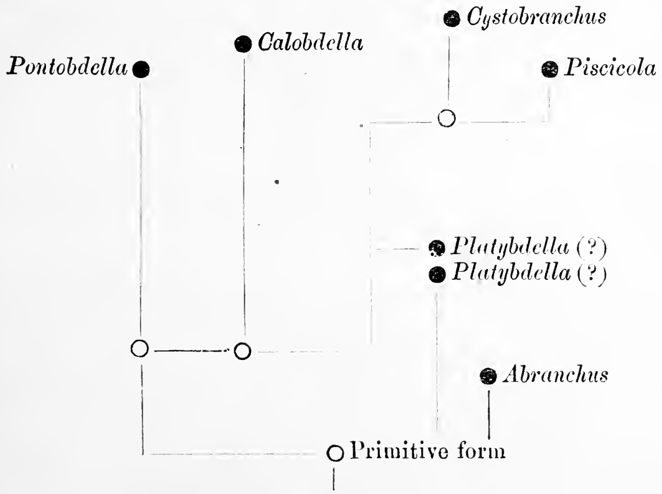
* Comptes Rendus, cxxvii. (1898) pp. 733–5.
† Zool. Anzeig., xxi. (1898) pp. 630–8 (5 figs.).
‡ Quart. Journ. Micr. Sci., xli. (1898) pp. 439–57 (4 pls.).

an organ without opening into the cœlom, and with a branching termination provided with tube-bearing flagellated cells. A ripe male specimen of *G. maculata* showed that the ciliated organ in this species acts as a genital duct or funnel, opening into the nephridial canal. The general conclusion is hinted at, that the ciliated organ is the morphological representative of the peritoneal or genital funnel of other Annelids, and probably of the Cœlomata in general.

New Japanese Earthworms.*—Prof. S. Goto and S. Hatai have published a first instalment of a series of studies on Japanese earthworms. This deals with species of *Perichæta*, of which 16 new forms are described; while in regard to *P. Sieboldii*, the strange fact is noted that none of the specimens quite agree with the description of the position of the spermathecæ given by European zoologists.

Habits of Pontobdella.†—The Hon. Henry Gibbs kept *Pontobdella muricata* in his tanks for about six months. Among the interesting facts observed, the following may be noted:—The leech showed no sensitiveness to the tentacles of sea-anemones; one of the few stimuli which excited it was a hand placed near it in the water; it paid no heed to a dead flounder, but fastened at once on a small dead skate dropped into the tank; it avoided living blennies, gobies, wrasse, &c., but attached itself to and sucked a living skate; it always appeared to dislike heat.

Structure and Affinities of Ichthyobdellida.‡—Herr L. Johansson describes some of the anatomical features of these leeches, and shows the impossibility of a natural classification which does not take account of the internal structure. The primitive form must have had a well developed body-cavity, two entirely separate intestinal cæca, a small and simple bursa, and reticulate inter-connected nephridia spreading around the body. The affinities of the genera may be represented thus:—



* Annot. Zool. Japon., ii. (1898) pp. 65–78 (14 figs. and a table).
† Journ. Marine Biol. Ass., v. (1898) pp. 330–2.
‡ Zool. Anzeig., xxi. (1898) pp. 581–95 (22 figs.).

Nematohelminthes.

Australian Nematodes.*—Dr. O. von Linstow describes *Filaria dentifera* sp. n., from the body-cavity of *Phalangista vulpecula*; *Echinonema cinctum* g. et sp. n., from the gut of *Ceratodus*; and *Amblyonema terdentatum* g. et sp. n., from *Dasypus hallucatus*. The two last-named forms are included among the Secernentes.

Mermis.†—Dr. O. von Linstow gives a useful account of the structure of *Mermis*, and of the collection in the Berlin Museum, which includes a number of new species. For *M. crassa* and *M. aquatilis* he proposes a new genus *Paramermis*, distinguished by the presence of only one spiculum.

Platyhelminthes.

New Swiss Turbellarians.‡—Herr W. Volz describes *Mesocastrada Fuhrmanni* g. et sp. n., belonging to the Mesostominæ, intermediate between *Mesostoma* and *Castrada*, and having one genital aperture, one ovary, two yolk-glands, a *bursa copulatrix*, testes of median length, an excretory organ opening into the pharyngeal pouch, and a copulatory organ which is peculiar, inasmuch as only the lower portion serves as an efferent duct for the semen. Among the other new forms described are *Castrada neocomensis* sp. n., and *Diplopenis* g. n., with two copulatory organs, which either do not serve as efferent ducts, or do so only in their lower portions.

Mesostoma aselli.§—Prof. J. Kennel found this new Turbellarian repeatedly in the brood-pouch of *Asellus aquaticus*, but was unable to determine whether it was a parasite, or whether it devoured the brood, or whether it was simply a commensal living on the infusorians and other small organisms in the pouch.

Cyathocephalus catinatus.‖—Dr. E. Riggenbach records this new species from *Solea vulgaris*. Its particular interest is that the scolex has only one sucker, a peculiarity which has hitherto been known only in *Cyathocephalus truncatus* Kessler.

Incertæ Sedis.

Position of Phoronis.¶—M. Louis Roule has studied the development of *Phoronis Sabatieri*, and his results do not agree well with Masterman's. There is in the Actinotrocha-stage an anterior diverticulum of the gut, whose cells show vacuolar degeneration, but it is unpaired and ventral. The nervous system consists of a cephalic plate and a median ventral plate, both destroyed in the metamorphosis; but Roule has seen nothing of the structural complexity described by Masterman, nothing, for instance, of a neuropore to the dorsal ganglion. The Actinotrocha is a modified Trochophore, and the adults are linked most closely to the Bryozoa, only very indirectly to the Vertebrata, which the author regards as derivable from reversed Annelids.

* Jena Denkschr., viii. (1898) pp. 469–74 (1 pl.).
† Arch. f. Mikr. Anat., liii. (1898) pp. 149–68 (1 pl.).
‡ Zool. Anzeig., xxi. (1898) pp. 605–12 (6 figs.).
§ Tom. cit., pp. 639–41. ‖ Tom. cit., p. 639.
¶ Comptes Rendus, cxxvii. (1898) pp. 633–6.

Rotatoria.

Two New Rotifers.*—Mr. J. E. Lord figures and describes two new species of Rotifers found by him in Yorkshire:—*Taphrocampa nitida* and *Callidina cataracta*, the latter characterised by strongly marked longitudinal ridges and eight rough spines in a row across the back, followed by a deep rounded depression. In this respect it is closely allied to Weber's *Callidina Brycei.*

Varieties of Anuræa cochlearis.†—Dr. Robt. Lauterborn gives an account of the variations in size and length of spines in this rotifer, observed by him for a number of years in the old channels of the Rhine near Ludwigshafen. In addition to the type species, he distinguishes the following three varieties:—*macracantha*, with very long posterior spine; *hispida*, covered with minute elevations; and *irregularis*, which has irregular markings. *A. tecta* is considered an extreme spineless variety of *A. cochlearis.*

Lauterborn's particular question is, whether the variations show any relation to the seasonal changes, and he answers it in the affirmative. About 2000 individuals were examined. The variations relate to the size and structure of the carapace and to the disposition of its plates.

The varieties known as *hispida* and *irregularis* are especially summer forms, and the variety *tecta* is also most abundant in the warm months. The same succession of varieties is observed in different localities; the size bears an undeniable relation to the temperature of the water.

Oogenesis and Maturation in Hydatina senta.‡—Dr. Lenssen begins his account with the period of ovum-formation. In an individual seven minutes old there are four mother-cells, which multiply rapidly and form ova, forty or so in three-quarters of an hour, each showing a peculiar nuclear cap. The next period is one of growth, which may be slow or rapid. The ova are detached and glide on the surface of the yolk-gland in the direction of the uterus, increasing in size as they do so. In the uterus the process of maturation begins. It seems that the parthenogenetic eggs which become females form a division-spindle, but do not liberate a polar globule. There is a distinct centrosome. In the eggs which become males there is a spherical refractive body in the ovum, and there are at least polar coronæ in the maturation spindle. In the "*Dauereier*," which are fertilised six hours after birth, the maturation spindle shows polar coronæ, and there is a vague hint of an expelled polar body.

Echinoderma.

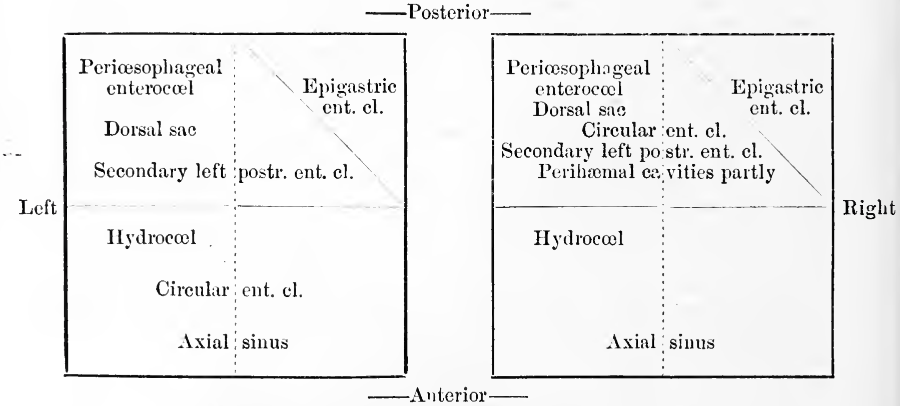
Respiratory Trees of Holothuroids.§—L. Bordas has made, at the Marine Laboratory of Endoume (Marseilles), a large number of observations on *Holothuria impatiens* Gmelin, *H. Poli* Delle Chiaje, *H. tubulosa* Gmelin, and *Stichopus regalis* Selenka. He succeeded in showing that the arborescent organs, which develop as diverticula from the gut, and are almost identical with it in histological structure, have at least four important functions. As has been generally recognised, they are respi-

* Journ. Quekett Micr. Club, vii. (1898) pp. 75–80 (1 pl.).
† Zool. Anzeig., xxi. (1898) pp. 597–604 (6 figs.).
‡ Tom. cit., pp. 617–22 (9 figs.); La Cellule, xiv. (1898) pp. 421–51 (2 pls).
§ Comptes Rendus, cxxvii. (1898) pp 568–70.

ratory; they have a hydrostatic function when the body is expanded; they produce numerous amœbocytes; and finally, the presence of uric acid and urates shows that they have excretory functions comparable to those of the renal organs of Vertebrates and of the Malpighian tubes of insects.

Asterid Development.—Prof. E. W. McBride [*] criticises Prof. S. Goto's account [†] of the development of *Asterias pallida*, and re-asserts two of his previous conclusions (1896),—(*a*) that the right hydrocœle is, after its origin, entirely isolated from the anterior cœlom, and (*b*) that the radial perihæmal canals have at first a cœlomic connection.

Cœlomic Cavities of Asteroids.[‡]—Prof. S. Goto has studied the development of *Asterina gibbosa*, and has compared his results with those reached by McBride, and with his own previous observations on *Asterias pallida*. The differences between the two species may be shown by the following diagrams, in which the four smaller squares represent the four portions of the larval enterocœl. The broken lines represent the partitions, real or imaginary, that obtain in the larva; the complete lines represent the partitions that persist in the adult. The names of the different cavities are written within the parts of the larval enterocœl from which they arise. The diagram may be directly derived from nature by viewing the larva from the ventral side and supposing the body to be cut open in the dorsal mid-line and spread out flat, and imagining the larval enterocœls as squares.



Asterias pallida *Asterina gibbosa*

Hybridism in Sea-Urchins.[§]—Mr. H. M. Vernon publishes the results of researches on the relation between hybrid and parent forms of Echinoid larvæ. The majority of his observations were confined to three species, *Strongylocentrotus lividus*, *Sphærechinus granularis*, and *Echinus microtuberculatus*. These species are not separated from each other by any rigidly defined physiological barrier, for there is present

* Zool. Anzeig., xxi. (1898) pp. 615–7.
† Journ. Coll. Sci. Tokio, v. Cf. this Journal, 1897, p. 129.
‡ Annot. Zool. Japon., ii. (1898) pp. 79–83 (3 figs.).
§ Phil. Trans., cxc. (1898) pp. 465–529.

a very general capacity for cross-fertilisation, and in the case of at least one hybrid (*Echinus* ♀ -*Strongylocentrotus* ♂) cross-fertilisation takes place with greater ease, and produces larvæ of larger size, than direct fertilisation.

As a rule the hybrid larvæ are of the maternal type, but some species have a much greater potency than others in the transmission of their characteristics. "The *Strongylocentrotus* ♀ -*Sphærechinus* ♂ hybrid is formed only at the time when the *Strongylocentrotus* ova have reached their minimum of maturity ; whilst in the case of the reciprocal hybrid it follows that, as the maturity of the *Strongylocentrotus* sperm increases, it is able to transmute first a portion and then the whole of the hybrid larvæ from *Sphærechinus* to its own type. In other words, *the characteristics of the hybrid offspring depend directly on the relative degrees of maturity of the sexual products.*"

Cœlentera.

Mesenteries and Siphonoglyphs in Metridium marginatum Milne-Edwards.*—Mr. G. H. Parker has investigated certain structural peculiarities in a single species of Actinian, *Metridium marginatum* Milne-Edwards, as represented by 131 adult specimens. He found that uniformity of structure was by no means a characteristic of the species. Of the specimens examined 77 had only one siphonoglyph, 53 had two, and a single individual possessed three such organs. This last must be considered exceptional, but the other two may fairly be regarded as typical, and may be styled the *monoglyphic* and *diglyphic* types. Such variation in the number of siphonoglyphs is not unusual among other Actinians, though it may not often be so pronounced. There is an exact correlation between the number of siphonoglyphs and of directive mesenteries, each siphonoglyph, even in the exceptional case of three, having one pair of directives attached to it. The non-directive mesenteries vary greatly in number. In the diglyphic type there were from four to ten pairs of non-directives, though the great majority had four pairs arranged in two groups of two pairs each, which is the assumed typical Hexactinian arrangement.

In the monoglyphic type there were from three to fourteen pairs of non-directives, and the great majority could be relegated to one of three structural sub-types characterised by five, six, and seven pairs respectively. The most important point in connection with the variations of the incomplete mesenteries was that, of the 131 specimens examined, *no two were alike.* Mr. Parker emphasises the necessity for examining a large number of specimens when investigating Actinians, that the possible error of regarding individual variations as characteristic of large groups may be avoided.

Protozoa.

New Amœba in Man.†—Prof. I. Ijima reports what seems to be a hitherto undescribed species of Rhizopod parasite in man. This parasite (*Amœba miurai*) was found in abundance in the serous fluid accumulation of the peritoneal and pleural cavities in a case of peritonitis and

* C.Z. Harvard, xxx. No. 5 (1897) pp. 259–72 (1 pl.).
† Annot. Zool. Japon., ii. (1898) pp. 85–94 (9 figs.).

pleuritis endotheliomatosa, but probably had its headquarters in the tumour tissue, since many of those found even in the fresh fluid were already dead or apparently dying. Its nearest allies are probably *A. villosa* Wallich and *A. fluida* Gruber.

Monograph of Craspedomonads.*—Herr Raoul H. Francé has done good service in monographing this interesting family (Bütschli's Choanoflagellata). He divides it into two sub-families, Codonosiginæ, including *Monosiga*, *Codonosiga*, *Codonocladium*, *Asterosiga*, *Sphæræca*, *Codonodesmus*, *Protospongia*, and *Diplosiga*; and Salpingœcinæ, including *Salpingœca*, *Lagenœca*, *Polyœca*, and *Diplosigopsis*.

The affinities are thus expressed:—

Dendromonadineæ
Anthophysa
Dendromonas
Cephalothamnium
|
Codonosiga
Codonocladium

Phalansterineæ *Phalansterium* —— Craspedomonadineæ —— *Oikomonas* Eumonadineæ

Salpingœca
|
Bicosœca
Bikœcineæ

Coccidian of Frog's Blood-corpuscles.†—Dr. E. Giglio-Tos records the occurrence of a Coccidian, whose precise nature remains undetermined, in those blood-corpuscles which are called "*Spindelzellen*" by Recklinghausen, "*hematoblastes*" by Hayem, "*piastrine nucleate*" by Bizzozero, and "*Thrombocyten*" by Dekhuyzen. This seems to be the first case recorded for these particular elements.

Stylococcus, a New Genus of Flagellatæ.‡—Under the name *Stylococcus aureus* g. et sp. n., Prof. R. Chodat describes an organism found in the Lake of Geneva, consisting of a roundish body resembling *Chromulina*, with a single immotile cilium several times its own length. It has a single golden yellow chromatophore, and is enclosed in a rounded capsule borne on a long stalk. It is reproduced by zoospores. The nearest alliance of this organism appears to be with the Chrysomonadineæ, near to *Chrysopyxis*, *Chrysococcus*, and *Dinobryon*. It was found in the mucus of a *Batrachospermum*.

* 'Der Organismus der Craspedomonaden,' 8vo, Budapest, 1897, pp. 1–112 (Hungarian), pp. 115–248 (the same in German), 78 figs.
† Atti r. Accad. Sci. Torino, xxxiii. (1898) pp. 924–31 (6 figs.).
‡ Bull. Herb. Boissier, vi. (1898) pp. 173–4 (1 fig.).

Coccidia with Ciliated Microgametes.*—M. Louis Léger previously observed the occurrence of locomotor cilia in the microgametes of *Barroussia caudata*, and he has found them also in *Echinospora ventricosa* sp. n. from the alimentary canal of *Lithobius hexodus*.

Hæmatozoa of Beri-Beri.†—Dr. F. Fajardo states that he has found in the blood of persons suffering from Beri-Beri, a hæmatozoon which forms spores, produces pigment, and whose developmental phases have a close resemblance to those of the malaria parasite. The hæmatozoon exists chiefly in the red corpuscles, but is also observed free in the plasma. It is a more or less spheroidal mass of protoplasm, which at first is devoid of pigment, but afterwards contains pigment granules. These granules are of variable colour, ranging from yellow and red to black, and are also of variable size and number. Sometimes vacuoles may be observed in the parasites.

* Comptes Rendus, cxxvii. (1898) pp. 418–20.
† Centralbl. Bakt. u. Par., 1[te] Abt., xxiv. (1898) pp. 558–68 (10 figs.).

BOTANY.

A. GENERAL, including the Anatomy and Physiology of the Phanerogamia.

α. Anatomy.

(1) Cell-Structure and Protoplasm.

Energid Theory of Sachs.* — Herr A. Hansen vigorously attacks Sachs' Energid theory, which he declares does not assist in solving any problems of vegetable biology, and often leads to absurdities, as when Köllicker speaks of "multinucleate energids," a contradiction in terms. Sachs himself terms the Siphoneæ "non-cellular," and at the same time defines a cell as a cell-wall enclosing one or more energids, a definition which would include the Siphoneæ. *Cladophora*, the separate cells of which are multinucleate, would have to be considered as a colony of colonies, or a colony of small simple Siphoneæ.

Action of Oxygen on the Movement of Protoplasm.†—Herr W. Kühne describes the effect of various reducing agents on the vital movement of protoplasm in the hairs on the filaments of *Tradescantia*. Pulverised iron arrested the movement immediately or within 5–15 m.; the power of recovery remained for two or three hours. In *Nitella* the protoplasm retains its power of streaming without access of oxygen for a comparatively long period, even as much as half an hour.

Accumulation of Protoplasm in Curved Pollen-tubes.‡ — Herr E. Mitschka finds that the pollen-tubes of *Narcissus Tazetta* germinate freely in a 7 per cent. solution of cane-sugar, and frequently assume a curved serpentine form; and there is then always found a considerable accumulation of protoplasm on the concave portions of the wall of the tube. Contrary to the statements of Wortmann with regard to a similar phenomenon in the case of hyphæ of *Phycomyces nitens*, this accumulation is the result, not the cause, of the curvature of the tube. Similar phenomena were observed in the pollen-tubes of *Camellia japonica* and *Digitalis ambigua*.

(2) Other Cell-Contents (including Secretions).

Leptomin.§—Herr M. Raciborski gives further instructions for the micro-chemical demonstration of the presence of leptomin, and dissents from Grüss's proposal for the distinction of three classes of oxydases. There is no good distinction between the β and the γ class; the diastases of the higher plants would belong sometimes to one, sometimes to the other class.

Iron in Plants.‖—Herr J. Stoklasa confirms the statement of Molisch that iron is not a necessary constituent of chlorophyll. He finds, on

* Biol. Centralbl., xviii. (1898) pp. 725–36.
† Zeitschr. f. Biol., xxxv. (1897) pp. 43-67; xxxvi. (1898) pp. 1–98. See Bot. Ztg., lvi. (1898) 2te Abth., p. 262.
‡ Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 164–9 (1 pl.).
§ Flora, lxxxv. (1898) pp. 362–7. Cf. this Journal, 1898, p. 551.
‖ Comptes Rendus, cxxvii. (1898) pp. 282–3. Cf. this Journal, 1892, p. 632.

the other hand (in bulbs of *Allium cepa* and seeds of *Pisum sativum*), a substance identical in chemical composition with animal hæmatogen. The same substance was found also in *Mucor mucedo*, *Boletus edulis*, and *Bacterium megaterium*. Its function appears to be to take part in the formation of the cell-nucleus in young organs; and the author believes iron to be, like phosphorus, an essential constituent of the nucleus.

(3) Structure of Tissues.

Histology of the Growing Point.*—Herr A. C. Hof has followed out the karyokinetic processes and the origin of vacuoles in the growing point, and the nature of the apical cell, in Pteridophyta, Gymnosperms (*Ephedra*), and Angiosperms (*Vicia*). The vegetative cone is surrounded by a well developed "calyptra," composed of superposed caps (in *Pteris* of only a single layer). The apical cell and the adjacent segments are distinguished by the small amount of cell-contents; the apical region is characterised by an abundance of vacuoles. The author confirms De Vries's statement of the origin of the vacuoles from others previously in existence; in other words, as Strasburger says, from the honeycomb-structure of the alveolarplasm; they are in no sense special organs of the protoplasm.

The karyokinetic processes are described in detail in the apex of the root of *Ephedra major* and *Vicia Faba*. The nuclear threads do not consist of alternate discs of linin and chromatin, but of an uninterrupted filament of linin in which discs of chromatin are imbedded. The chromosomes have mostly a J-form. During metakinesis they become arranged into a diaster. The daughter-knot-stages are derived on both sides from the chromosomes of the diaster, and this process ends in the formation of the two daughter-nuclei with a reticulate chromatin-framework. Finally, the author is of opinion that the multipolar and bipolar origins of the nuclear spindle are not essentially distinct, but are connected by intermediate processes.

Healing-Tissue in Plants.†—M. J. Massart treats in detail of the various modes in which wounds are healed in plants.

In Algæ with free filaments, two modes are exhibited:—A lateral outgrowth of the nearest cell below, and a proliferation of the injured cell by the upper and under adjacent cells. In Algæ which form plates of cells, the row whose terminal cell is injured ceases to grow, and the adjoining cells fill up the vacancy. In Algæ with a more complicated thallus, it is only the parts destroyed that are regenerated, whether growing points or older elements. Among Fungi some are able to regenerate the lost portions, while others have not this capacity. Heteromerous Lichens form a new cortical layer.

Muscineæ and Pteridophyta show, in general, but little power of recovery from injuries; the Marattiaceæ replace the lost tissues by cell-division, but there is no formation of cork.

Among Phanerogams there are two chief processes which take place in the adjacent tissues:—an elongation of the meristematic cells towards the wound, together with the formation of numerous walls parallel to

* Bot. Centralbl., lxxvi. (1898) pp. 65–9, 113–8, 166–71, 221–6 (2 pls.).

† 'La Cicatrisation chez les végétaux': Mém. couronnés Acad. r. de Belgique, 1898, 68 pp., 57 figs.

the surface; and the formation of cork. It is probable that direct division of the nucleus always takes place in the phellogen resulting from a wound. The spread of the irritation caused by a wound is slow; dead elements, as vessels and fibres, do not conduct it. The author believes that a chemical process always underlies the propagation of the irritation. In *Nuphar* and other water plants, cavities near to the wound are filled up by freshly formed cells. The formation of cork is promoted by the drying up of the surface of the wound.

Mucilaginous Epiderm of Leaves.*—Herr O. Kruch has investigated the frequent occurrence of mucilage in the epiderm of Dicotyledons. This takes the form of a mucilaginous layer on the inner or on both the inner and outer walls of the epidermal cells. The author has paid special attention to the examples occurring in the order Rosaceæ, where the phenomenon is frequent in nearly all the families.

The formation of mucilage appears to have a distinct connection with assimilation, since it occurs only in cells which are in direct contact with assimilating cells. It never takes place on the lateral walls of epidermal cells; and when the epiderm consists of several layers, it is confined to the inner walls of the lowermost layer. The property is never common to the whole of the epidermal cells, but belongs only to certain cells with very variable distribution. In the Rosaceæ the mucilage always takes the form of a secondary thickening of the wall, separated from the protoplasm by a layer of cellulose.

The author regards the mucilage layer as a reservoir of water protecting the surface against excessive transpiration.

Development of the Leaf and Origin of the Foliar Vascular Bundle.†—Herr V. Deiniga has studied this subject, which he subdivides under the following heads:—(1) The development and the course of the bundles in typical monocotyledonous plants; (2) Dicotyledonous plants with monocotyledonous venation; (3) Monocotyledonous plants with abnormal venation; (4) Dicotyledonous plants with typical reticulate venation; (5) The development of palm leaves. Under (2) the plants chiefly studied were *Eryngium* and *Bupleurum falcatum*; under (3) *Richardia æthiopica*, *Xanthosoma*, *Caladium*, and *Dioscorea brasiliensis*.

As a general result, the author states that the development of the vascular bundle depends on the form of the leaf. The bundle which is first formed runs straight to the apex; the others curving according to the degree of development of the two halves of the lamina. In all the plants examined, however complicated the branching and anastomosing of the veins in the mature leaf, the venation can always be traced back to the simplest type where all the bundles are independent and unbranched.

Stem of the Beet.‡—According to M. G. Fron, the increase in thickness of the stem of the beet is not effected, as in the root, by the formation of successive generating layers, but by the gradual shifting outwardly of a single layer. This layer, at first of normal origin, becomes later partly normal and partly pericyclic, and finally completely

* Annuar. r. Ist. Bot. Roma, vi. pp. 191–274 (2 pls). See Bot. Centralbl., lxxvi. (1898) p. 16.
† Flora, lxxxv. (1898) pp. 439–98 (1 pl., 22 figs.).
‡ Comptes Rendus, cxxvii. (1898) pp. 397–400 (3 figs.).

pericyclic. At each outward displacement of the layer outside the vascular bundles, there takes place, within and without each phloem island, a kind of doubling of the generating zone, whatever its origin. The course of the foliar bundles is in a wavy line, each bundle continuing through a space of three internodes before passing into the leaf.

Stem of Scorzonera.*—Herr A. Peter describes the anatomical structure of the stem of *Scorzonera*, and classifies the species under groups, characterised by differences in the disposition and structure of the vascular bundles. This does not always go along with an arrangement of the species derived from morphological characters.

Conversion of Cellulose into Mucilage.†—Herr O. Rosenberg has studied the formation of the layer of mucilage in the seeds of *Magonia glabrata*, belonging to the Sapindaceæ. It differs from that of other mucilaginous seeds in the fact that it is derived, not from the lower or the lateral walls of the epidermal cells, but from a layer underlying the epiderm. The mucilage-tissue in the seed differs but little from that in the leaf. The object of the structure appears to be, by the absorption of water, to protect the embryo from desiccation.

(4) Structure of Organs.

Female Flower and Inflorescence of Cannabineæ.‡—Herr N. Zwinger has studied in detail the structure of the female flower and the mode of fertilisation in *Cannabis*, *Humulus*, and allied genera.

In the hemp the female flowers are not associated in an inflorescence, but are solitary in the axils of the bracts on branches of various orders. In *Humulus* there occur transitional conditions from the solitary position in *Cannabis* to the inflorescence of the hop. The bracts of the female plants of Cannabineæ are the leaves in whose axils the flowers are formed. The perianth of the female flower is composed of two independent leaves; in the hemp it is often entirely aborted, or the posterior leaf only is developed. The pistil is formed from the floral axis as well as from the two carpellary leaves; but it is only the anterior leaf which takes part in the formation of the wall of the ovary, while the other leaf forms simply the posterior part of the style. The ovule, as in most Monochlamydeæ, is formed from the apex of the floral axis; the elevated position of the ovules in the upper part of the ovary is due to the elongation of the internode which separates the two carpels. The two integuments coalesce with one another from the posterior side of the ovule.

When the ovule is ready for impregnation, the micropyle has become entirely obliterated. When the pollen-tube has penetrated the style, it makes its way within the tissue of the ovule, and finally reaches the nucellus; thus presenting a close analogy to the chalazogamy of the elm. The placentation of the Cannabineæ indicates that they cannot be descended from porogamous plants.

* Nachr. k. Gesell. Wiss. Göttingen, 1898, pp. 9–20.
† Bih. k. Svensk. Vetensk.-Akad. Handl., xxiii. (1898) Afd. 3 (18 pp., 1 pl., 3 figs.) German).
‡ Flora, lxxxv. (1898) pp. 189–253 (5 pls., 2 figs.).

Formation of the Pollen in Magnolia.*—M. L. Guignard points out an interesting peculiarity in the mode of formation of the pollen in the species of *Magnolia* examined (*M. Yulan*, *M. Soulangeana*, &c.). The rule is that in Monocotyledons the first division of the mother-cell nucleus is followed by the septation of the latter, the two daughter-cells then dividing in the same way; while in Dicotyledons the first division of the nucleus is not followed by the septation of the mother-cell, which does not take place until after the second division, between the 4 nuclei thus formed. The only important exception to this rule is in the case of the Orchideæ, which follow the dicotyledonous type. In *Magnolia* we find a process intermediate between the two. After the first division of the nucleus, an imperfect septum makes its appearance between the two daughter-nuclei, which is very rarely completely formed before the second division takes place.

Anatomy of Orchideæ.†—Herr E. Capeder deals with the origin and development chiefly of the floral organs, in the following genera and species of Orchideæ:—*Cypripedium*, the Ophrydeæ, *Calanthe veratrifolia*, *Epipactis*, *Mikrostylis monophyllos*, *Listera*, *Neottia*, *Goodyera repens*.

He has determined the interesting fact, that, while in *Cypripedium calceolus* the number of stamen-rudiments is four, in *C. barbatum* there are six, in conformity with the normal monocotyledonous type. The author employs the term *clinandrium*, in a different sense from that of some other writers, to define that part of the flower of an orchid which lies behind the stamen, and is an outgrowth from its posterior side. Its structure can be especially well observed in *Listera ovata*. Darwin describes this part of the flower erroneously as an expansion of the apex of the column.

Structure and Function of Awns.‡—Herr B. Schmid enters in great detail into the structure of the awn in grasses, especially in our cereal crops. In addition to the biological functions of protection against herbivorous animals (which he regards as efficient only to a very slight extent), and of dissemination by adhering to the hairy skins of mammalia or the feathers of birds, awns answer two important physiological functions in the life of grasses; they increase the amount of transpiration and the power of assimilation of the plant. These statements are supported by a number of tables.

Dimorphism in Curtia.§—In *Curtia tenuifolia*, a Brazilian plant belonging to the Gentianaceæ, Herr J. O. A. Malme records the existence of a dimorphism in the flowers (heterostyly), very similar to that in *Primula*. It is the only species of the genus in which this peculiarity is known to occur; in the nearly allied *C. tenerrima*, possibly only a variety of *tenuifolia*, the stigmas and anthers are always nearly on the same level.

Bog-Plants.‖—Herr N. H. Nilsson enumerates all the bog-plants in Sweden, and assigns to them the following characters as a class:—The

* Comptes Rendus, cxxvii. (1898) pp. 594–6.
† Flora, lxxxv. (1898) pp. 368–423 (2 pls., 21 figs.).
‡ Bot. Centralbl., lxxvi. (1898) pp. 1–9, 36–41, 70–6, 118–28, 156–66, 212–21, 264–70, 301–7, 328–34 (2 pls.).
§ Ofv. k. Vetensk.-Akad. Förhandl., lv. (1898) pp. 305–13 (3 figs.) (German).
‖ Bot. Ver. Lund. See Bot. Centralbl., lxxvi. (1898) p. 9.

large size of the transpiring surface in comparison with the transpiring mass; the position of the leaves and other characters which serve to diminish transpiration; the thickness of the cuticle, deposition of wax, formation of mucilage, &c.; the number, size, distribution, position, and structure of the stomates; special peculiarities of individual species. Contrivances for reducing transpiration appear to be as necessary for bog as for xerophilous plants. It may often happen, therefore, as in *Carex*, that we find in the same genus, bog-species and xerophilous species with very little apparent difference in structure. With regard to the stomates, all the bog-species examined possess the power of closing them; as a rule they are closed at night.

Polymorphy of the Spruce Fir.*—Herr C. Schröter describes in detail the variations which occur in the spruce fir, *Picea excelsa*, in the habit, the size of the cones, the size and shape of the leaves, and other morphological characters. He derives from his observations the general conclusions that a variation in a given direction may be much more stable in one species of *Pinus* than in another, and that the same peculiarity of habit or of some special point of structure may be induced in different species by quite different causes.

Spiral Structure of the Roots of Chenopodiaceæ.†—M. G. Fron attempts to explain in the following way the spiral structure of the roots of certain Chenopodiaceæ belonging to the sub-orders Spirolobeæ (*Suæda*, *Salsola*) and Cyclolobeæ (*Beta*, *Spinacia*, *Atriplex*, *Chenopodium*). The seed presents, on longitudinal section, an embryo surrounding a copious starchy endosperm. During its development the embryo, attached to the suspensor by the radicle, coils all round the endosperm, the cotyledons absorbing only a small quantity of the nutrient material which surrounds them. The apex of the cotyledons comes into contact with the radicle, but, as it continues to develope, covers it on the inner side along its whole length, and compresses it. This mechanical compression of the cotyledons on the radicle causes an asymmetry of structure, which is shown, on transverse section, by the arrangement of the tissues in a double spiral.

Roots of Bignonia.‡—Mr. T. G. Hill decides in the affirmative the disputed question whether the roots of *Bignonia* exhibit the same anomalous structure as the stem. The peculiarity consists in the arrest of the development of the secondary xylem, the depressions thus formed being filled up by wedge-shaped masses of phloem. Four of these phloem-wedges occur in the root as well as the stem. The roots of *B. unguis* also possess the peculiarity of swelling out at intervals into tuberous growths.

β. Physiology.

(1) Reproduction and Embryology.

Embryology of Aconitum.§—In the mode of impregnation and the development of the embryo in *Aconitum Napellus*, Herr A. Osterwalder

* Vierteljahrsschr. Naturf. Gesell. Zürich, xliii. (1898) pp. 125–252 (37 figs., 1 table).

† Comptes Rendus, cxxv. (1898) pp. 563–5.

‡ Ann. of Bot., xii. (1898) pp. 323–8 (1 pl.).

§ Flora, lxxxv. (1898) pp. 254–92 (6 pls.).

finds nothing that deviates widely from what has been observed in other Dicotyledons. The embryo-sac is derived from the lowest of the four cells resulting from the division of the archespore. The reduction in the number of chromosomes appears to take place in the archespore, the morphological equivalent of the pollen-mother-cell. After the embryo-sac has divided, the sac doubles in both length and breadth. A peculiarity observed in *Aconitum* was the great increase in size and the permanence of the antipodals, which completely fill up the beak-like lower part of the embryo-sac. They probably play an important part in the nutrition of the embryo. The nuclei of the antipodals, of the egg-apparatus, and of the two pollen-nuclei, each possess a single nucleole, those of the antipodal-nuclei being comparatively large.

Two cases of polyembryony were observed, both indicating that the synergids are degenerated egg-cells or archegones which still retain the potentiality of being impregnated. The mode of primary division of the embryo, up to its 3- or 5-celled condition, varies in different individuals. The division of the primary endosperm-nucleus may be completed before the fusion has taken place of the sperm-nucleus with the ovum-nucleus.

Hermaphroditism in Mercurialis and Cannabis.*—From a number of examples of inflorescence in the hemp which partook partly of a male, partly of a female character, M. M. Molliard draws the following conclusions. The perianth of the female flower is homologous to the calyx of the male flower. The flower is fundamentally unisexual. The pistil is composed of two carpels. Pollen-mother-cells may develope after the fashion of embryo-sac-mother-cells. The sex is not absolutely determined in the seed, but may be modified by abnormal conditions. A transformation may be observed from male to female inflorescences under conditions that are very unfavourable to the development of the vegetative organs, especially under the influence of a feeble illumination.

Similar results were obtained with *Mercurialis annua*.

Determination of Sex in Plants.†—Carrying on his researches on this subject, M. M. Molliard now states that, in the case of *Mercurialis annua*, a high temperature favours the production of female individuals. Whether the action is simply one of promoting especially the germination of female seeds, or whether it incites an actual change in the seeds themselves, is at present undetermined.

(2) Nutrition and Growth (including Germination, and Movements of Fluids).

Laws of Growth.‡—Sig. L. Montemartini has studied the phenomena of growth of the apices of shoots, especially in plants with opposite leaves, e.g. *Cannabis*, *Ricinus*, and *Helianthus*. It is frequently the case that a larger number of internodes develope in one period of growth than the number in the bud at the commencement of that period. The activity of the meristem in the apex obeys a law of periodicity of its own, independent of the external conditions under which the meristem is developed.

* Rev. Gén. de Bot. (Bonnier), x. (1898) pp. 321–34 (13 figs.).
† Comptes Rendus, cxxvii. (1898) pp. 669–71. Cf. this Journal, 1898, p. 100.
‡ Atti Ist. Bot. r. Univ. Padova, 1898, 69 pp. See Bot. Centralbl., lxxvi. (1898) p. 273. Cf. this Journal, 1897, p. 409.

Biology of Tropical Orchids.*—M. M. Raciborski records the results of observations on the structure and mode of life of Javanese orchids. Out of 63 species observed, 61 were epiphytes; of these latter 27 were monopodial, 34 sympodial.

The minute seeds of the epiphytic orchids are dispersed by means of elaters; and in two species of *Aerides* the epidermal cells of the testa are provided with barbed projections, by means of which the seed is anchored to the substratum. In a terrestrial species of *Eulophia* the walls of the epidermal cells are furnished with lignified annular and spiral thickenings; these cells eagerly absorb water, and the small embryo lies buried in an aquiferous tissue.

Several species of *Aerides* present the peculiarity that all the individuals in a district appear to blossom on the same day.

In all the monopodial species examined the embryo was undifferentiated; the first product of germination was a dorsiventral germ-plant, triangular in transverse section, and attached to the substratum by rhizoids. From its similarity to a similar structure in *Lycopodium*, the author terms this stage the *protocorm*. The protocorm is here an assimilating organ which can propagate by budding, and subsequently produces a leaf-bearing growing point. It has usually only a temporary existence.

Some of the epiphytic species are not propagated by seeds, but only in a vegetative mode. In *Dendrobium mutabile* the lamina of the leaf is deciduous, while the sheath remains in a dried-up condition. The leafy lateral shoots spring from the leafless primary shoots; some of them produce inflorescences, others aerial roots which grow in all directions, and attach the plant to the branches of the host-plant.

A remarkable case of mimicry is recorded, in the flower-buds of *Renanthera moschifera*, which bear a remarkable resemblance to the head of a serpent.

Rhynchostelis retusa forms long thick aerial roots, the apices of which are covered by a thick colourless mucilage, not produced by special hairs, as in other epiphytic orchids, but on the outside of the thin walls of epidermal cells.

The young inflorescence of *Aerides virens* is covered by a sweet syrupy fluid, which attracts large numbers of ants, and protects the young flower-buds. Later this fluid dries up to a collodion-like pellicle enveloping the whole bud, and falling off from the margins of the sepals when the flowers open.

In several species there are produced in the axil of each leaf in basipetal succession a row of from two to eight axillary shoots, of which only the uppermost one usually attains full development.

In a *Trichoglottis* sp. the entire surface of the leaf is covered by a thick cuticle, the stomates lying in a deep and narrow channel.

In *Aeriopsis javanica* the roots form a dense weft, among which are imbedded the "pseudo-bulbils," each composed of two lower internodes, surrounded by the dry transparent leaf-sheaths, and bearing at the apex from two to four leaves.

Several epiphytic orchids present contrivances for the absorption of water through the leaves.

* Flora, lxxxv. (1898) pp. 325-55 (13 figs.)

Periodicity in the Growth in Thickness of Trees.*—Herr J. Wieler criticises the statements of previous writers on this subject, and gives the result of observations of his own. In even closely contiguous spots the growth in thickness of trunks is often very far from uniform. There are in general, both with Conifers and Dicotyledons, two periods of greatest activity, about the beginning of June and the middle of July. This later period of activity is subject to very great variations. The period of greatest activity in the development and unfolding of the buds does not necessarily agree with that of the cambium.

Periodical Growth in Hevea brasiliensis.†—Herr J. Huber calls attention to the intermittent growth in this rubber-producing tree, which may be divided into three phases:—(1) A rapid elongation of the axis, both between the upper bud-scales and between the succeeding young leaves; (2) The development of the leaves in the succeeding phase, during which they attain their full size, but hang limp; (3) The full development of the tissue of the leaf, when the leaves gradually assume a nearly horizontal position, with their characteristic consistence. Each phase may extend over about ten days, with intermediate pauses of about the same length.

Dormant Life in Bulbs and Tubers.‡—M. Leclerc du Sablon points out that in bulbs and tubers the resting period is not the winter, but the summer, vegetation commencing again in the autumn. They have, therefore, to protect themselves rather against drought than against cold. The reserve carbohydrates are chiefly starch, inulin, dextrose, and saccharose; glucose is rarely present, except in *Allium* and *Asphodelus.* During the period of repose, chemical changes are going on in the reserve without any external change in form; digestion has commenced; and the bulb or tuber is brought into a state fit for germination; diastases, which were almost entirely wanting at the commencement of that period, being gradually formed.

Growth of Arum maculatum.§—Mrs. R. Scott and Miss E. Sargant have followed out the growth of this plant from the seed, which is exceedingly slow, the first leaf not appearing above the ground till the third year, nor a flowering shoot till the seventh. During the first two years there is no formation of chlorophyll in any part of the plant; the contractile roots have a most powerful effect in dragging it below the surface. The internal morphology and histology of the young seedling are described in detail.

Change of a Perennial into an Annual Plant.‖—From observations made on the scarlet-runner, *Phaseolus multiflorus*, Dr. R. v. Wettstein has come to the conclusion that it is originally, in its native state, a perennial plant; and that it has been unable to hibernate with us, owing to our climatic conditions, and has hence become annual under cultivation. By altering the conditions, he was able to maintain life in the same individual for four years, but with diminished vigour.

* Tharander Forst. Jahrb., xlviii. (1898) 100 pp. See Bot. Ztg., lvi. (1898) 2[te] Abth., p. 260.
† Bot. Centralbl., lxvi. (1898) pp. 259–64.
‡ Comptes Rendus, cxxvii. (1898) pp. 671–3.
§ Ann. of Bot., xii. (1898) pp. 399–414 (1 pl.).
‖ Oesterr. Bot. Zeitschr., 1897, No. 12, and 1898, No. 1 (13 pp., 3 figs.).

Action of Cold and Sunlight on Aquatic Plants.*—Dr. A. J. Ewart replies to the criticisms of W. and G. S. West on his previous publication on the action of cold on aquatic plants. Certain algæ (though not all) are very sensitive to a depression of temperature to near the freezing point; and this is especially the case with cells in a motile condition. It is probable that no purely aquatic fresh-water plant can withstand complete freezing when in an actively vegetating condition. It is certain that intense illumination acts injuriously upon all exposed living parts of plants, and not only on the cells containing chlorophyll, although these are first affected. In living chloroplastids exposed to light, the decomposition and reconstruction of chlorophyll proceed simultaneously, and in certain cases the total amount formed in a single day may be several times greater than that present at any given moment.

Assimilation.†—Prof. C. E. Barnes objects to the term assimilation for the process of manufacture of carbohydrate foods, and proposes the general adoption of either one of two terms that have been suggested,—"photosynthesis" or "phototaxis." Assimilation might then be reserved for the repairing of waste and for the formation of new parts.

Absorption of Carbohydrates by Roots.‡—From experiments made on the cultivation of wheat, maize, pea, and other plants, M. J. Laurent concludes that, in most green plants there are probably two modes in which carbon is assimilated,—the chlorophyll-function, and the absorption of certain organic compounds after digestion by the root. The mode of nutrition of non-chlorophyllaceous plants is only a particular case of that of green plants in general.

Chlorophyll-assimilation of Littoral Plants.§—From observations made on a variety of plants growing on the sea-shore, M. E. Griffon concludes that in the leaves of maritime plants a reduction of the amount of chlorophyll takes place under the influence of the sodium chloride, while the leaves and stems acquire a greater thickness and a larger development of the assimilating tissues. This increase, however, does not neutralise the injurious effects of the sodium chloride, the assimilation calculated for a unit of surface being always reduced.

Action of Chloroform on Carbon dioxide Assimilation.‖—From experiments on *Elodea canadensis*, Dr. A. J. Ewart confirms the statement that chloroformed water-plants cease to evolve bubbles of oxygen in the light, but recover this power immediately if the chlorophyll be at once removed. After immersion for five minutes the plant loses the power of recovery. With a more dilute solution, the power of recovery is not lost even after a longer immersion.

(3) Irritability.

Action of External Irritation on Plants.¶—The shoots of *Cucurbita Pepo* display strongly marked plagiotropism. Herr F. Czapek has

* Ann. of Bot., xii. (1898) pp. 363–97. Cf. this Journal, 1898, p. 453.
† Bot. Centralbl., lxxvi. (1898) pp. 257–9.
‡ Comptes Rendus, cxxvii. (1898) pp. 786–7. Cf. this Journal, 1898, p. 101.
§ Tom. cit., pp. 449–52.
‖ Ann. of Bot., xii. (1898) pp. 415–7.
¶ Flora, lxxxv. (1898) pp. 424–38 (1 pl., 3 figs.).

investigated the cause of this by growing plants in a pot strongly illuminated from one side. The hypocotyl is orthotropous, and is positively phototropic when illuminated on one side. This property is retained during the whole of its development; it is never plagiotropic, and never becomes phototropic even on the strongest insolation. The experiments made determined that light is the cause of the plagiotropic change in the originally orthotropous shoot.

The origin was also investigated of the inversion of the lower part of the lamina displayed by many (but not all) species of *Alstrœmeria*, a phenomenon exhibited also by a considerable number of grasses, and by some other plants. The examination of very young leaves of *A. psittacina* and *pelegrina* showed that the stomates are developed on the morphological upper surface before the torsion becomes externally visible on the erect unopened young leaves. Experiments with the clinostat showed that the cause of the torsion is photo-irritation. The author advocates the view that, in the course of the phylogenetic development of the genus, the twisted have originated from erect paraphototropic leaves; this view being confirmed by the fact that there are still some species with erect leaves.

Contact Irritability in Hook-climbers.*—According to Dr. A. J. Ewart, there is every form of gradation between the simpler form of climbing hooks, such as occur in *Uncaria*, and the highly specialised tendrils of the *Passiflora* type. From the simplest type (*Rubus fruticosus*, *Acacia*, *Cæsalpinia*, &c.) where the hooks are simply protective and their use in climbing purely accidental, we pass to others (*Luvunga*) which possess both non-irritable spines and irritable climbing hooks, and a further stage (*Uncaria*, *Artabotrys*) in which the spines have disappeared, and the irritable clasping hooks alone remain. A further advance is shown by *Roucheria* and *Ancistrocladus*, where, besides the thickening, the sensitive region shows a slight increased curvature due to contact alone. The differentiation between concave and convex surfaces, as regards irritability, is more strongly displayed in *Bauhinia*. The highest type is represented by the tendrils of *Cucurbita*, *Passiflora*, *Sicyos*, &c., and the root-tendrils of *Vanilla*, which exhibit rapid curvature as the result of contact alone.

No hard and fast line can be drawn between a contact and a pressure stimulus. Irritable hooks respond to pressure more readily than tendrils, the irritability being confined almost entirely to the concave surface of the hook. When the curvature is produced slowly, it is probably due to an unequal growth of the cambium of the two surfaces.

Heliotropism caused by Diffused Daylight.†—Herr J. Wiesner has taken a series of photographs of the seedlings of a dicotyledon (*Vicia sativa*) grown in diffused daylight. The following are the chief conclusions.

Although the organs of a plant often possess an enormous capacity for heliotropic reaction, they always grow towards the strongest light when illuminated by diffused light which radiates from all sides. The part which has become heliotropic divides the area of light which

* Ann. Jard. Bot. Buitenzorg, xv. (1898) pp. 187–242 (2 pls., 5 figs.) (English).
† Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 158–63.

reaches it exactly symmetrically in reference to the various intensities of light. It follows that the part of a plant exposed to diffused daylight must receive an infinitely large number of light-impulses; but the action of these impulses is largely negatived in relation to the direction of growth of the organ, so that those impulses only are effective which are not neutralised by an equivalent impulse in the opposite direction.

Influence of Light on the Form and Structure of Branches.*—Observations made by M. Maige on the Virginian creeper and the ground-ivy lead to the following general conclusions. Diffused light favours the formation of climbing or creeping branches, and may cause the transformation of a flowering shoot into a climbing or creeping shoot; while direct light produces the contrary effects. Diffused light, acting on climbing or creeping branches, increases in them the morphological and anatomical characters which adapt them to climbing or creeping habits; while direct light produces the contrary effect.

Influence of Gravity and Light on the Dorsiventral Structure of Branches.†—From experiments, chiefly on the branches of the umbel in the Umbelliferæ, M. H. Ricome concludes that solar radiation intensifies the characters proper to an assimilating tissue on the side facing the light. The action of gravity is shown in the unequal size of the cells of oblique branches; they are larger on the side facing the light. The combined influence of light and heat determines the form of the branch. The illuminated surface is usually the upper surface. This is the cause of the frequent folding of the upper surface of many pedicels, the object of which is to increase the surface occupied by the assimilating tissue in the furrows, and to allow at the same time of the development of the supporting tissue at the sides. This combined influence greatly modifies the arrangement of the vascular bundles. The dorsiventrality of the oblique branches of an inflorescence must be regarded as a radiar structure modified by the combined influence of solar radiation and gravity.

Rectipetality.‡—An example of this phenomenon—the tendency of an organ to straighten itself after having been curved by the action of an external irritation—is recorded by Herr F. G. Kohl. Growing stems of *Allium atropurpureum* and *Tradescantia virginica*—the former consisting of a single, the latter of many internodes—were laid horizontal, and allowed to erect themselves by the agency of geotropism. In the former case the erect stems remained curved, while in the latter case they became nearly straight. The author lays stress on the fact that it is only in the nodes that geotropic, heliotropic, and other kinds of irritation can arise, though they can be propagated through the internodes.

(4) Chemical Changes (including Respiration and Fermentation).

Changes in Oily Seeds during Germination.§—From experiments made chiefly on *Arachis* and *Ricinus*, M. L. Maquenne has come to the

* Comptes Rendus, cxxvii. (1898) pp. 420–3.
† Tom. cit., pp. 436–9 (2 figs.). Cf. this Journal, 1898, p. 209.
‡ Ber. Deutsch. Bot. Gesell, xvi. (1898) pp. 169–73 (2 figs.).
§ Comptes Rendus, cxxvii. (1898) pp. 625–8.

conclusion that the question whether the constituents of oily seeds are transformed directly into carbohydrates during germination, must be answered in a different way in different cases. In the former case arachidic acid appears to contribute but very slightly to the production of sugars; while in the latter case ricinoleic acid (an incomplete acid-alcohol) plays an important part in this reaction. The difference is probably due to differences in the arrangement of the molecules in the formative substances.

Decomposition of Proteids with Formation of Asparagin and Glutamin in Seedlings.*—Herr E. Schulze confirms Suzuki's statement that asparagin and argenin can be produced in leaves from ammonia formed during the decomposition of proteids. The decomposition of proteids in seedlings consists in the hydrolytic breaking up of the proteid molecules.

Formation of Albumen in the Germination of Onion-Bulbs.†—In the germination in the dark of bulbs of *Allium Cepa*, Herr W. Zaleski has been able to determine a considerable increase in the proteid substances, rising from 32 to as much as 52·5 per cent. Their formation is, however, dependent on certain conditions, especially on the presence of considerable quantities of carbohydrates. The bulbs contain a much smaller proportion of reserve proteids than do the seeds. It is only at a late period of germination, in the case of the onion, that the quantity of proteids begins to decrease. The amount of asparagin remains constant during germination. The formation of proteids in the dark cannot be due exclusively to asparagin and glutamin.

Alcoholic Fermentation without Yeast-cells.‡—Herren E. Buchner and R. Rapp obtain in the following manner a yellow powder completely soluble in water which has nearly the same power of inducing fermentation as yeast. 500 ccm. of freshly expressed yeast-juice is mixed with a few drops of olive oil, and evaporated rapidly under diminished pressure at 20°–25° C. to a syrupy consistency. This syrup is spread on glass plates and dried for about a day; the residue is then scraped off, and dried further under sulphuric acid.

γ. General.

Conception of Species.§—In his address as President to the Botanical Section of the A.A.A.S. at Boston, Prof. W. G. Farlow dwells on the changes which have taken place in the conception of species during recent years, his illustrations being taken entirely from the family of Fungi. He lays stress on the fact that theoretical considerations with regard to evolution play a much less important part than they did when the Darwinian hypothesis first came to be generally accepted. "The best systematist is not he who attempts to make his species conform to

* Chem. Ztg., xxi. (1897) pp. 625–8. See Journ. Chem. Soc., 1898, Abstr., ii. p. 481. Cf. this Journal, 1898, p. 103.
† Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 147–51.
‡ Ber. Deutsch. Chem. Gesell., xxxi. (1898) pp. 1531–3. See Journ. Chem. Soc., 1898, Abstr., ii. p. 480. Cf. this Journal, 1898, p. 219.
§ Amer. Naturalist, xxxii. (1898) pp. 675–95.

what he believes to be the ideal of nature, but he who, availing himself of all the information which the histology, embryology, and ecology of the day can furnish, defines his species within broad rather than narrow limits, in clear and sharply cut words which can be readily comprehended, and do not force one to resort to original and perhaps single specimens to learn what the author of the species really meant."

Myrmecophilous Plants.*—Herr W. Taliew adds the following to the list of known myrmecophilous plants:—*Pæonia tenuifolia*, *Vicia Faba*, *V. sepium*, *V. pannonica*, *V. grandiflora* var. *Biebersteinii*, *V. truncatula*, *V. sativa*, *Centaurea ruthenica*, *C. montana* var. *axillaris*, *Fraxinus excelsior*, *Lamium album*, *Iris Gueldenstaedtiana*. The author disputes the benefit of myrmecophily to the plant infested by the ants, its flowers being often destroyed by them.

Ant-gardens.†—M. M. Raciborski describes a species of Ampelideæ, *Leea hirsuta*, a native of Java, in which "food-bodies" are produced, which are greedily devoured by ants, and are difficult to detect, from the eagerness with which the ants consume them. They consist of small round bodies, borne on the young parts of the stem or on the young leaves, most abundantly on the leaf-stalks. The cells are filled with starch-grains and large drops of oil.

Value of Hybrids in Plant-breeding.‡—Mr. W. T. Swingle and Mr. H. J. Webber give a detailed account of the production of hybrids and of their value in plant-breeding. They describe the methods used in producing hybrids, their characters in relation to those of the parent plants, the preponderating influence of one parent in determining the characters, the prepotency of pollen from one plant over that from another, the increased vigour of hybrids and cross-bred plants, the direct action of foreign pollen on parts of the mother-plant, the production of graft-hybrids, and other points of special value to the plant-grower.

Temperature of Plants.§—Herr F. Schleichert has made some interesting observations on the temperature of trunks and leaves. In *Pavia rubra*, the temperature in the interior of the trunk, at a depth of 12 cm. below the surface, was found to be in the first place dependent on that of the surrounding air, attaining its maximum and minimum some hours later than that of the atmosphere, viz. the former about midnight, the latter between noon and 3 p.m. It is also, however, influenced to a less extent by the temperature of the soil and of the ascending current of water, and by the degree to which the leaves are exposed to direct sunlight. The temperature of the leaves was found to be in some cases slightly (0·7° C.) below that of the surrounding air, owing to transpiration; but in other cases (aloe, cactus) much higher, when exposed to bright sunshine (28·5° as compared with 20°). This is not due to a development of heat in the leaf, but to the absorption of heat through the thick mass of the leaf (or stem).

* Arb. Naturf. Gesell. k. Univ. Charkow, Beilage, 1898, pp. 41–4. See Bot. Centralbl., 1898, Beih., p. 93.
† Flora, lxxxv. (1898) pp. 257–61 (1 fig.).
‡ Year-book Department of Agriculture U.S., 1897, pp. 381–420 (2 pls., 13 figs.).
§ Naturw. Wochenschr., xiii. (1898) pp. 469–72.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Fertilisation of Onoclea.*—Mr. W. R. Shaw has investigated the process of impregnation in *Onoclea sensibilis* and *O. Struthiopteris*, with the following results. The antherozoids are held in large numbers in the mucilage at the mouth of the archegone, and remain unchanged for a long period. Long before the archegone opens, the egg-cell comes to the resting condition, and contains one or more nucleoles. The antherozoids lose their vesicles on first entering the mucilage. Very shortly after the entrance of the antherozoids into the archegone, the canal is closed by the expansion of the four proximal neck-cells and the four just beyond them.

The body of the free antherozoid consists of a long corkscrew-shaped nucleus which stains homogeneously, and a lateral band of cytoplasm which extends a short distance in front of the nucleus. The sperm-nucleus enters the egg-nucleus before it changes in form or visible structure. Within the egg-nucleus the chromatin-granules of the sperm-nucleus slowly separate as the meshes of the linin-network enlarge. Throughout the process of fertilisation the female nucleus remains in the resting condition. The first division of the egg was in no case found until more than a week after fertilisation.

Blepharoplasts of Onoclea and Marsilia.†—Mr. W. R. Shaw finds that, in *Onoclea Struthiopteris* and *Marsilia vestita*, the blepharoplasts originate, not in the spermatids (the mother-cells of the antherozoids), as stated by Belajeff, but in the mother-cells of the spermatids. They remain in the neighbourhood of the spindle-pole during the whole of the cell-division which leads to the formation of the spermatids. They are not identical with the centrosomes found in other classes of plants. In *Marsilia* the formation of the blepharoplasts is preceded by the appearance, in the mother-cells of the spermatids, of peculiar bodies, termed by the author *blepharoplastoids*, resembling the blepharoplasts, but disappearing after a short existence.

In *Onoclea sensibilis* each antherid forms 16, or more often 32 spermatids. The blepharoplasts move from two opposite points of the cell towards the nucleus, and appear to increase equally in size. They are spherical, and without any visible structure; they probably remain in the neighbourhood of the spindle-pole during the whole process of division.

Muscineæ.

Cyathophorum pennatum.‡—Sig. U. Brizi publishes a detailed account of the biology and morphology of this Australian moss, a saprophyte growing in humus at the base of tree-ferns, which can also live as a parasite. There is a sharp differentiation between the aerial stem and the underground rhizome, especially in the structure of the epiderm.

* Ann. of Bot., xii. (1898) pp. 261–85 (1 pl.).

† Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 177–84 (1 pl.). Cf. this Journal, 1898, p. 550.

‡ Ann. r. Ist. Bot. Roma, vi. (1897) pp. 275–369. See Bot. Centralbl,. lxxvi. (1898) p. 93.

The leaves are monostromatic, with distinct bundle-elements. All the species of this tropical family, the Cyathophoreæ, are diœcious, both male and female inflorescences occurring in the axil of lateral leaves. Under the term *maculæ* (*Makeln*), the author describes peculiar organs which occur on the aerial stem and rhizome of *Cyathophorum pennatum*, *C. Adiantum*, and *Spiridens Veillardii*:—large round white dots arranged in two regular rows. Their function was not determined, but they are probably water-storing organs.

Elaters of Hepaticæ.*—Herr Z. Kamerling points out that, while the mechanical principle is always the same in the following kinds of movement,—the bending of the teeth of the peristome of mosses, the bursting of the anther-lobe and of the sporange of ferns,—the movements of the elaters of Hepaticæ depend on quite different principles in different cases:—(1) They may be caused by a shrinking of the membrane or of special layers of the membrane, as in the peristome of mosses (*Dendroceros*, some species of *Anthoceros*); (2) The movement may be one of cohesion; this is much the most common; (3) The movement is brought about by the drying up of the thinner portions of the cell-wall tangentially more strongly than other portions (some species of *Anthoceros*); (4) The movement may be described as passive, not dependent directly on the structure of the parts themselves, but on an external cause brought about by movements in other parts (*Frullania*).

In *Dendroceros* the elater consists of a single very long spiral band. In *Anthoceros* there are no less than three different types of elater.

Algæ.

Perforating Algæ.†—From a study of the littoral algæ of the Lake of Geneva, Prof. R. Chodat classifies those which have the power of penetrating solid substances into two groups, the perforating and the corroding algæ, of which the former, fixed to the shells of bivalves, are much the less common. To this group belongs a new genus *Foreliella*, represented by *F. perforans* g. et sp. n., with the following generic diagnosis:—Filaments straight, branching dichotomously, slender, growing vertically into the calcareous shells of *Anodonta*; at the outer surface more branched, and terminating in inflated cells connected into a pseudo-parenchyme; sporanges terminal, without starch; cells of the filaments 10–11 times as long as broad, containing starch-grains; chromatophores parietal, furnished with starch-grains.

Gongrosira codiolifera and *Hyella jurana* spp. nn. are also described.

Development of the Florideæ.‡—From a careful examination of several of the higher Florideæ—especially *Dudresnaya purpurifera*, *D. coccinea*, *Glœosiphonia capillaris*, *Callithamnion corymbosum*, *Dasya elegans*—Prof. F. Oltmanns contests F. Schmitz's view that a double act of impregnation takes place in the Florideæ. The only act of fertilisation is the fusion between the male nucleus of the pollinoid and the female nucleus of the carpogone, resulting in the production of "the sporogenous nucleus"; and the development of this sporogenous

* Flora, lxxxv. (1898) pp. 157–69 (7 figs.).
† Bull. Herb. Boissier, vi. (1898) pp. 431–56 (3 figs.).
‡ Bot. Ztg., lvi. (1898) 1te Abth., pp. 99–140 (4 pls., 1 fig.).

nucleus is now described in detail. For the term "ooblastema filament" he proposes to substitute "sporogenous filaments."

In *Dudresnaya purpurifera*, when the protoplasm of the sporogenous cell fuses with that of the auxiliary cell, no fusion of the two nuclei takes place; on the contrary, the nucleus of the auxiliary cell travels away from the sporogenous nucleus to the most distant part of its cell. After a time the sporogenous nucleus moves towards the sporogenous half of the cell, where the sporogenous filament is formed which makes its way between the vegetative branches of the thallus. When the sporogenous filament unites with the terminal cell of a lateral branch, there is again no fusion of the nuclei; they remain far apart, the auxiliary nucleus gradually decreasing in size.

The same general results were obtained in the other species examined. In *Glœosiphonia capillaris,* after the fusion of the sporogenous filament and the auxiliary cell, the auxiliary nucleus divides into two, and these two sister nuclei move towards the centre of the fused cell, close to the sporogenous nucleus. In *Callithamnion corymbosum* and *Dasya elegans* also, the nucleus of the auxiliary cell and the sporogenous nucleus remain near each other without fusing.

Without maintaining any true alternation of generations in the Florideæ, Oltmanns distinguishes between the gametophyte or the structure which bears the sexual organs, and the sporophyte which bears the spores. The tetraspores are regarded as secondary organs of propagation comparable to gemmæ. In the simplest cases the sporophyte forms the simple glomerule; but it is frequently represented by filaments growing among the cells and branches of the gametophyte, which enter into a characteristic union with special cells, the auxiliary cells; but there is here no true fertilisation; rather a process of the nature of a parasitism of the sporogenous on the auxiliary cell.

Prof. Oltmanns frames a scheme of phylogenetic development of the Florideæ, rising from *Nemalion*, through three lines of ascent, to the Rhodomeleæ, *Corallina*, and *Champia*.

Structure and Development of Soranthera.*—Miss Ethel S. Barton has studied the life-history of this genus of Phæophyceæ, of which the only known species, *S. ulvoidea*, is truly parasitic on *Rhodomela Larix*, being attached to it by rhizoids which penetrate the host-plant. The young plant consists of filaments radiating from the base, the cells at the surface bearing free assimilative filaments, like those of *Chordaria*. With the growth of the plant the internal structure is stretched and torn apart, leaving the centre empty. The assimilative filaments are shed, and the cells which bear them connect up to form a peripheral layer. Outgrowths which resemble plurilocular sporanges are associated with the assimilative filaments; and unilocular sporanges, together with paraphyses, surround cryptostomates in the later stages of the plant. The systematic position of *Soranthera* is at present doubtful; it presents resemblances both to the Chordariaceæ and to the Encœliaceæ.

Phæoschizochlamys, a new Genus of Phæophyceæ.†—Under the name *Phæoschizochlamys mucosa* g. et sp. n., Herr E. Lemmermann de-

* Journ. Linn. Soc. (Bot.), xxxiii. (1898) pp. 479–82 (2 pls.).
† Abhandl. Natur-ver. Bremen, xiv. (1898) pp. 501–12 (1 pl.). See Hedwigia, xxxvii. (1898) Rep., p. 158.

scribes a fresh-water alga from the island of Wangerooge, differing from *Schizochlamys* only in the brown colour of the chromatophores.

Fructification of Chnoospora.*—From a study of the fructification of *Chnoospora fastigiata*, especially from the presence of cryptostomates forming the centre of sori of plurilocular sporanges, Miss Ethel S. Barton removes that genus from the Sporochnoideæ, and places it among the Encœliaceæ, near to *Hydroclathrus* and *Colpomenia*.

Action of Light on Mesocarpus.†—Mr. F. J. Lewis confirms previous observations as to the effect of light in causing a turning of the plate of chlorophyll in the cells of *Mesocarpus*, amounting after 30 minutes to an angle of 90°. In diffused light the chlorophyll-plate places itself at right angles to the incident light; while in strong sunlight the edge of the plate is turned towards the source of insolation. On continued insolation the plate becomes curved.

Structure of Diatoms.‡—Herr P. Mitrophanow furnishes a contribution to this subject in a detailed account of a marine species of *Striatella*. He describes its external form, the structure of the shell and of the chromatophores, the pyrenoids, and the nuclei. The valve consists of a number of bands or *pleuræ*, attached to one another by their margins, which are readily separated from one another by pressure. He claims to have observed gelatinous pseudopodes passing through openings in the valve. The pyrenoids are not solitary, but are grouped together in spheres and rosettes. The only mode of division of the nuclei observed was a direct one; karyokinetic division he believes to take place in diatoms only under exceptionally favourable conditions.

Structure of Codiaceæ.§—Herr E. Küster gives the results of the study of the Adriatic species of Codiaceæ, belonging to the genera *Codium*, *Udotea*, and *Halimeda*.

In the thallus of *Codium* two kinds of filament are to be distinguished,—the first with narrow diameter running either in a tangential (*C. bursa*, *adhærens*) or in a longitudinal (*C. tomentosum*) direction; the second broad, peripheral, and springing vertically from the former. The former kind the author terms "axial," the latter "palisade-tubes," these latter being merely the ends of the first kind of filament. From the base of each palisade-tube springs a slender filament by sympodial branching, which again takes up the original direction of the axial filament. The palisade-tube is always finally cut off from the supporting axial tube by a septum consisting entirely of cellulose, and resulting from the gradual extension inwards of a thickening-ring near the base of the palisade-tube. The "hairs" of *Codium* (*C. tomentosum*) are narrow erect branches springing from near the apex of the palisade-tubes, and nearly, but not quite, completely septated from it by a cellulose-thickening formed on one side only near their base. They are probably aborted sporanges. The thallus of *Codium* is fixed to the substratum by numerous long bent attachment-filaments.

In *Udotea* (*U. Desfontainii*) and *Halimeda* (*H. Tuna*) there is no

* Journ. Linn. Soc. (Bot.), xxxiii. (1898) pp. 507–8 (1 pl.).
† Ann. of Bot., xii. (1898) pp. 418–21.
‡ Flora, lxxxv. (1898) pp. 293–314. § Tom. cit., pp. 170–88 (5 figs.).

septation of the thallus like that of *Codium*, but, in the former genus, a considerable secondary thickening of the wall of the tube. These two genera are also distinguished from *Codium* by the power of regeneration of detached portions of the thallus.

Notwithstanding these biological differences, the author regards the Codiaceæ as forming a well-defined natural group.

Caulerpa.*—Mdme. A. Weber Van Bosse gives a monograph of the family Caulerpeæ, composed of the single genus *Caulerpa*, which she thus defines:—Green Algæ with multinucleate thallus, unicellular, and traversed by anastomosing cords of cellulose; propagation non-sexual, by detached fragments of the thallus; spores unknown. The thallus is composed of a creeping tube (the stolon is very rarely wanting), which puts out rhizoids on its lower surface, and fronds on its upper surface; the fronds vary greatly in form, are usually ascending, but sometimes creeping, simple, but branched. The 53 species, some of them new, are arranged by the authoress in 12 sections.

Pleodorina illinoisensis.†—Under this name Dr. C. A. Kofoid describes a new species from plankton on the Illinois river, and gives the following diagnosis of the genus. Colony consists of a spherical or elliptical cœnobe of greenish biflagellate cells of two types, vegetative and gonidial, in the anterior and posterior parts of the colony respectively, which lie in the periphery of a hyaline gelatinous matrix, and are surrounded by a common hyaline envelope. Cells each with one reddish eye-spot, which is more prominent in the anterior part of the colony. No connecting filaments between the cells. Non-sexual propagation by gonids, which are formed by increase in size of a part of the cells of the colony. Daughter-cells escape from the parent-cells as small colonies of biflagellate cells which at this stage are all similar. Sexual reproduction unknown.

Chlamydomonadineæ.‡—M. P. A. Dangeard gives the following as the result of recent observations on this group of Algæ, comprising the genera *Chlorogonium*, *Phacotus*, *Carteria*, and *Chlamydomonas*, which he regards as "the principal pivot of the vegetable kingdom."

A distinct boundary can almost always be detected between the protoplasm and the chloroleucite. The single chloroleucite is sometimes traversed by protoplasmic trabecules. The protoplasm is homogeneous or granular, while the chloroleucite is alveolar. The structure of the nucleus varies much. The karyokinetic mode of division occurs in nearly all the genera; the number of chromosomes is constant in the same species, but varies in the different species and genera. The process does not differ in any essential point from that in the higher plants. The number of chromosomes is the same in the ordinary sporanges and in the gametosporanges; in the latter it remains constant during the successive bipartitions; no reduction takes place before impregnation; the probable time is the germination of the ovum. When the two gametes conjugate to form the ovum, the two nuclei present no appreciable difference in size or structure; they are obviously attracted

* Ann. Jard. Bot. Buitenzorg, xv. (1898) pp. 243–401 (15 pls.).
† Bull. Illinois State Lab. Nat. Hist., v. (1898) pp. 273–93 (2 pls.).
‡ Comptes Rendus, cxxvii. (1898) pp. 736–8.

to one another; the nuclear membrane disappears; the two nucleoles remain for a time distinct and then fuse together. The phenomenon presents no difference from that which occurs in some of the higher plants.

Fungi.

Soluble Proteo-hydrolytic Ferment in Fungi.*—In addition to the soluble ferments already detected in Fungi—invertin, trehalase, maltase, inulase, amylase, and emulsin—MM. E. Bourquelot and H. Hérissey now find, in 20 out of 26 species of the larger Fungi examined—notably in *Amanita muscaria* and *Clitocybe nebularis*—a ferment capable of digesting casein, in some cases completely. The presence was proved of a soluble proteo-hydrolytic ferment analogous to trypsin, if not identical with it.

Distribution of Starch affected by Fungi.†—Prof. B. D. Halsted calls attention to the fact that in the parts of plants attacked by parasitic fungi—whether the leaf, stem, or root—there is a considerable accumulation of starch, as was shown by the ordinary iodine test. Striking examples are furnished in the cases of *Zea Mays* attacked by *Ustilago Maydis*, the turnip attacked by *Plasmodiophora Brassicæ*, and in the tubercles formed by *Rhizobium Leguminosarum* in the roots of Leguminosæ. It is probably due to increased respiration, as in the parts of plants that have been wounded.

Tropical Fungi.‡—Herr C. Holtermann has made a number of interesting mycological observations in Ceylon, Java, Borneo, and the Straits Settlements.

To the small number of forms of the Hemiasci, intermediate between the Zygomycetes and the Ascomycetes, he adds two new genera. *Oscarbrefeldia pellucida* g. et sp. n. was found in a mucilaginous matrix at Buitenzorg. It is distinguished by its septated light brown or nearly white mycelial filaments, at the apex of which are seated large conids, which are often replaced by sporanges containing a very variable number of spores, between 1 and 70. The author asserts that the sporanges contain no true nuclei, the spore-division being quite independent of any such structures.

Conidiscus paradoxus g. et sp. n. was found in similar situations. The mycele is copiously branched and septated, and produces conids which have the power of becoming transformed into sporanges. The conidiophores vary enormously in form, and the number of spores in a sporange, and the mode of their attachment, are also subject to great variation. The sporanges are simply conids which form spores endogenously.

In the Auricularieæ, he finds the number of cells of which the basids are formed to be variable. A new genus is founded on *Tjibodasia pezizoides* g. et sp. n., in which the receptacle, instead of being gelatinous, is of a wax-like consistence and resembles that of a *Peziza*. The fertile

* Comptes Rendus, cxxvii. (1898) pp. 666–9. Cf. this Journal, 1896, p. 656.
† Bull. Torrey Bot. Club, xxv. (1898) pp. 573–9.
‡ Mykol. Unters. a. d. Tropen, Berlin, 1898, viii. and 122 pp. (12 pls.).

disc is gymnocarpous, the basids are septated transversely, the number of cells varying up to nine.

In the Dacryomycetes, the author sinks the genera *Dacryomitra*, *Guepinia*, and *Ditiola*, in *Calocera*, retaining only that genus and *Dacryomyces*.

Among the Tremellineæ, a new genus *Clavariopsis* is described, allied to *Tremella*, and with its typical basids, but resembling *Clavaria* in the form of the fructification. Several other new species are described. The genus *Exidiopsis* is sunk in *Exidia*.

In discussing the phylogenetic relationship of the various families of Fungi, the author criticises unfavourably in several points the conclusions of Brefeld; laying far less stress than does that author on the mode of fructification in determining relationship. He believes there exist sharply defined groups of Fungi, which have very little or no recognisable relation to one another.

Actinomucor, a New Genus of Mucorini.*—On pigeon's excrement Herr W. Schostakowitsch finds a saprophytic fungus, easily cultivable on the bodies of flies in water, which he makes the type of a new genus, with the name *Actinomucor repens* g. et sp. n. It differs from *Mucor* in its very long and slender branched sporangiophores, the branches being frequently in whorls, and ending in a single larger sporange, surrounded by a whorl of smaller ones. No mode of sexual reproduction is described.

Endomyces albicans.†—M. P. Vuillemin has studied the development of this fungus, the cause of the disease of plants known as "muguet." It produces both exogenous and endogenous spores; but the true organs of reproduction are asci, which are spherical or ellipsoidal, and usually contain four spores, rarely two or three, of a flattened elliptical form. From this limitation of the number of spores, he rejects the various positions which have hitherto been assigned to this fungus, in the genera *Oidium*, *Spirotrichum*, *Stemphylium*, *Mycoderma*, and *Monilia*, and on other considerations its alliance with *Saccharomyces*; and places it in *Endomyces* among the true Ascomycetes.

Parasitic Fungi.—M. A. Prunet ‡ gives a detailed account of the injuries inflicted on the vine by the black-rot, for which he adopts the name *Guignardia Bidwellii*, of the life-history of the fungus, and of the internal and external conditions which render the host-plant especially liable to its attacks.

M. L. Mangin § finds a disease of the base of the haulm in wheat to be due to the attacks of two parasitic fungi, *Ophiobolus graminis* and *Leptosphæria herpotrichoides*, which penetrate the lowermost internodes of the stem, or in some cases, the root.

Mr. J. W. Reed ‖ describes in detail the æcidioform of *Uromyces Pisi* occurring on *Euphorbia cyparissias*.

To the small known number of species of *Synchytrium* parasitic on Monocotyledons, Herr F. Bubák ¶ adds a new species, *S. Niesslii*, found on *Ornithogalum umbellatum*.

* Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 155–8 (1 pl.).
† Comptes Rendus, cxxvii. (1898) pp. 630–3.
‡ Rev. Gén. de Bot. (Bonnier), x. (1898) pp. 129–41, 404–42.
§ Comptes Rendus, cxxvii. (1898) pp. 286–8.
‖ Journ. Quekett Micr. Club, vii. (1898) pp. 68–74 (1 pl., 1 fig.).
¶ Oesterr. Bot. Zeitschr., xlvii. (1898) pp. 241–2.

Herr A. Nilsson * finds the following fungi belonging to the Uredineæ parasitic on the pine in Sweden :—*Chrysomyxa Ledi*, *Ch. Abietis*, *Æcidium corruscans*, *Æ. conorum Piceæ*, and *Æ. strobilinum*. The pine-forests are nowhere attacked by *Chrysomyxa Ledi* except in the neighbourhood of *Ledum palustre*.

Under the name *Æcidium Opuntiæ* sp. n., Herr P. Magnus † describes a parasitic fungus which attacks species of *Opuntia* in South America.

Relationship between the Pezizeæ and the Helvelleæ.‡—Herr G. Dittrich points out the forms which display intermediate points of structure between these two groups of fungi. The stipitate Pezizeæ (e. g. *Peziza macropus*) closely resemble certain simply organised species of *Helvella* in their early stages. The apotheces both of many Pezizeæ and of the Helvelleæ may be derived from structures resembling the peritheces of the Pyrenomycetes. Attention is also called to the angiocarpous origin of the hymenium in certain Helvellineæ.

Pyxine.§—In a description of the Lichens of the first Regnell expedition, Dr. G. O. A. N. Malme gives a monograph of this genus, with a general account of its structure. He finds no evidence of the syntrophy ascribed to this genus by Minx. Seven species are described, two of them new.

Biology of Yeasts.‖—M. J. A. Cordier contests the statement that insects play an important part in the dissemination of *Saccharomyces* on ripe fruits, at all events in Champagne, where the ripening of the grape does not take place till the 12th or 18th of October, when hardly any insects are on the wing. The chief agent there is undoubtedly the wind. At the time of the vintage the thallus of *Dematium pullulans* is in a state of great fragmentation, while true *Saccharomyces* is present in but small quantities. It is the abundance of *Dematium pullulans* in the flower of the vine that gives it its characteristic vanilla-like odour.

Saccharomyces ruber.¶—Sig. O. Casagrandi describes under the name of *Saccharomyces ruber*, a blastomycete which he isolated from diabetic urine. When injected into the subcutaneous connective tissue, an inflammatory and suppurating swelling is produced. These tumours are quite like those produced by other blastomycetes and by oidial forms described by Sanfelice. When mixed with milk it causes diarrhœa. In itself it is harmless, but it has the power of exciting changes in milk which is then capable of producing gastro-enteric disturbances in animals (rabbits, dogs) and in children.

Conversion of Mould Fungi into Alcohol Yeasts.**—Herr A. Jörgensen, in a preliminary communication on the genetic connection of alcohol yeasts and mould fungi, states that the experimental proof of the conversion of a *Dematium* into an alcohol yeast fungus which occurs

* Tidsk. f. Skogohnshällning, 1898, pp. 89–105. See Bot. Centralbl., lxxvi. (1898) p. 282.
† Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 151–3 (1 pl.).
‡ JB. Schles. Gesell. vaterl. Cultur, xv. (1898) Zool.-bot. Sect., pp. 16–9.
§ Bih. k. Svensk. Vetensk.-Akad. Handl., xxiii. (1898) Afd. 3, 40 pp. (German).
‖ Comptes Rendus, cxxvii. (1898) pp. 628–30. Cf. this Journal, 1898, p. 112.
¶ Ann. d'Igiene sperim., viii. See Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) p. 757.
** Centralbl. f. Bakt. u. Par., 2te Abt., iv. (1898) p. 860. Cf. this Journal, 1896, p. 341.

exclusively as a sprouting yeast fungus, and its re-conversion into a mould fungus, has been attained. The conditions under which this conversion takes place will shortly be published *in extenso*, as also will the conditions in which endogenous spores appear in a mould fungus having all the characteristics of *Dematium pullulans*.

Variation in Teleutospores.*—Mr. J. A. Warren points out the great variation in the number of cells in the teleutospores of *Puccinia Windsoriæ*. Out of 572 spores examined, 27 consisted of 3 or 4 cells instead of the normal number of 2. Sometimes the basal, and sometimes the apical cell would be divided by a longitudinal septum; the 3 or 4 cells were sometimes arranged in a row, or, in the latter case, the 4 cells had sometimes a cruciform arrangement.

Uredineæ.†—In the commencement of a monograph of the Swiss species of Uredineæ, Herr E. Fischer gives the result of a number of new culture-experiments and observations on different species, together with some general conclusions. He adduces examples of the phenomenon that certain heterœcious Uredineæ produce, on the host-plants of the æcidial generation, "leptoforms," less often "microforms" or "hemiforms," the teleutospores of which agree nearly or entirely with those of the heterœcious species. The same host-species, growing in different districts, may exhibit different powers of resistance to infection by the same parasitic fungus. Species are described in detail belonging to the genera *Gymnosporangium*, *Cronartium*, and *Coleosporium*.

New Genera of Uredineæ.‡—Among the results of the first Regnell expedition, Herr H. O. Juel finds material for establishing two new genera of Uredineæ.

Chaconia g. n. Teleutosporæ e cellulis basalibus successive enatæ, non pedicellatæ, unicellulares, membrana tenui præditæ, statim germinantes, promycelio apicali brevissimo, quadricellulari, sporidia gignente; pycnidia, æcidia, uredo, ignotæ.

Leptinia g. n. Teleutosporæ e strato subepidermali cellularum brunnescentium successive enatæ, e cellulis binis inter se oblique connatis compositæ, membrana tenuissima instructæ, poris carentes, pedicellatæ; germinatio fere *Leptopucciniæ*; pycnidia, æcidia, uredo, ignotæ.

Classification of Agaricaceæ.§—Engler and Prantl propose the division of the Agaricaceæ into the following families:—Cantharelleæ, Paxilleæ, Coprineæ, Hygrophoreæ, Lactariaceæ, Schizophylleæ, Marasmieæ, and Agariceæ.

Thermophilous Microbes.‖—Dr. Tsiklinsky records two examples of *Actinomyces* vegetating between 48° and 68° C. *Thermoactinomyces* i., isolated from the soil, presents itself as wavy, straight, and ramified filaments, about 0·5 μ broad. It forms spores. It is easily stained by the ordinary anilin dyes and also by Gram's method. It vegetates from

* Amer. Nat., xxxii. (1898) pp. 779–81 (26 figs.).

† Entwickel.-Unters. üb. Rostpilze, Bern, 1898, Bd. 1, Heft 1, 121 pp., 2 pls., 16 figs.

‡ Bih. k. Svensk. Vetensk.-Akad. Handl., xxiii. (1898) Afd. 3, 30 pp., 4 pls. (German).

§ Engler u. Prantl, Natürl. Pflanzenfamilien, i. 1, Leipzig, 1898. See Hedwigia, xxxvii. (1898) Rep., p. 170.

‖ Ann. de Micrographie, x. (1898) pp. 286–8.

48°–68°, its optimum temperature being 57°. It grows well on all the ordinary solid and liquid media. Macroscopically the cultures do not differ in the least from those of ordinary *Actinomyces*. Microscopically these cultures show filaments of variable length, which are spiral and much branched. Some bear spores at their ends. The fungus liquefies gelatin, coagulates milk, imparting thereto an acid reaction; it does not form a diastatic ferment, and is not pathogenic to laboratory animals.

The second species was isolated from manure. The filaments and spores are much larger than those of the first species, and it does not liquefy gelatin. In other respects it closely resembles *Thermoactinomyces* i.

Besides the two foregoing species, the author describes a fungus much higher in the scale of organisation than any thermophilous microbe yet described. From its organs of fructification it appears to be related to the Mucorineæ. This fungus presents a downy mycele, and under the Microscope sporanges at the ends of ramified mycelial filaments are easily discernible. It is easily stained by the ordinary anilin pigments and by Gram's method. It grows well on the ordinary media, but best on white bread. It liquefies gelatin and secretes a proteolytic ferment. It produces invertin and coagulates milk. Its optimum temperature lies between 53° and 65°; it is incultivable at 37°, and at 48° its growth is only feeble. It forms spores on solid substrata in 2–3 days, but not at all in liquid media.

Protophyta.

α. Schizophyceæ.

Stipitococcus, a New Genus of Protococcaceæ.*—Messrs. W. and G. S. West describe, along with a number of new species of Algæ, a new genus with the following diagnosis:—Cellulæ epiphyticæ, gregariæ, minutæ, stipite hyalino tenuissimo longo affixæ, base subrotundata, apice sæpe apiculato, nonnunquam producto, deinde irregulariter expanso, a vertice visæ circulares; contentus cellularum late viridis, chromatophora singula parietali curvata et irregulari, plasma granulosa; propagatio ignota. *Stipitococcus urceolatus* sp. n., is epiphytic on a *Mougeotia*; the very slender hyaline stem has possibly been formed from the single cilium of a zoospore.

β. Schizomycetes.

Action of Bacteria on the Photographic Film.†—Prof. P. Frankland records four sets of experiments which had for their object to ascertain whether living structures may not be endowed with the power of recording their presence on the sensitive film. From these preliminary experiments the author infers that bacterial cultures are capable of affecting the photographic film, even at a distance of half an inch; whilst when placed in contact with the film, definite pictures of bacterial growths can be obtained. As the action does not take place through glass, it is in all probability due to the evolution of volatile chemical substances which either directly or indirectly enter into reaction with

* Journ. of Bot., xxxvi. (1898) p. 336.
† Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 609–12.

the sensitive film. The action appears to be exerted by liquefying as well as by non-liquefying bacteria. Luminous bacteria, e.g. *Photobacterium phosphorescens*, exert a more powerful action on the photographic plate than the non-luminous, and this action is moreover not perceptibly diminished by the interposition of a glass plate.

Some Thames Bacteria.*—Prof. H. M. Ward describes four bacteria which were isolated from Thames water.

(1) A short colourless bacterium, forming stearine-like colonies, and belonging to the type of *Bacterium Ureæ* (Jaksch). It is not uncommon in the Thames. Morphologically it is a coccus about 1 μ in diameter, non-motile, occurring singly, in pairs, in rows of four, or in heaps, and formed by the breaking up of rodlets 2 $\times$ 1 μ. On plates at 12°–15° C., the colonies are white, irregularly circular, radiately striated, with indented edges. The gelatin is not liquefied, and after some days the centre of the colonies becomes yellowish. On agar the growth is a dull waxy white; the colonies sometimes coalesce to form a film having the appearance of a polygonal turbot-scale-like mosaic. On potato the growth, at 22°, is yellowish white, dry, waxy. On all the solid substrata the colonies are stearine-like. In liquid media a white deposit is formed. The organism is easily stained, but not by Gram's method. It is not pathogenic to guinea-pigs.

(2) A colourless capsuled coccus or bacterium. This organism, when examined from plates, is an oval non-motile rodlet, over 1 μ long and from 0·75–1 μ broad. It is invested by a tough dense zooglœa or capsule, which occurs round groups of dividing rodlets as well as round individual cocci or rods. The organism was cultivated in the ordinary media, and grew well on most. Gelatin was liquefied. The growth, at first white, became yellowish in time, especially on potato and agar. Beef-broth cultures were pathogenic to guinea-pigs. Observations made on hanging drops showed that at temperatures from 23·5°–25° active swarming took place.

(3) A rose-pink *Micrococcus*. This organism, which occurs as spherical cocci, varying in diameter from 0·5–1·5 μ, is of the type *M. carneus* (Zimm.). This organism is interesting partly on account of the production of red pigment, but also from exhibiting two growth-forms. For this *Micrococcus* forms evident *Sarcina*-like groups when young and growing slowly; while later, and when development is rapid, the grouping is botryoidal and *Staphylococcus*-like. The organism was cultivated on all the usual media, but only agar, potato, and gelatin gave satisfactory results. The gelatin was slowly liquefied.

(4) A pseudo-bacillus. This occurs as irregular and often curved rods 4 $\times$ 1 μ, motionless, often with spore-like bodies in them, and breaking up into cocci. The cocci are found only in old gelatin cultures. No true endogenous spores were observed. The growth is white or yellowish-white or flesh-coloured. In broth the motionless rods measure 2–3 $\times$ 1–1·2 μ, and may grow out to segmented filaments 10–12 μ long. On plates at 12°–15° C. the colonies are yellowish-white. Micro-cultures in hanging drops of gelatin and of broth showed that the organism was not a true Schizomycete, but an oidium stage of an extremely minute fun-

* Ann. of Bot., xii. (1898) pp. 287–322 (4 pls.).

gus. Yet tested by all other bacteriological methods this pseudo-bacillus is a bacterium, and only the hanging drop method showed apical growth, acropetal mode of branching, and appearances common among Basidiomycetes. Hence minuteness, staining reactions, rapid growth, and the characters obtained in plate cultures, do not prove that an organism is a Schizomycete, and this point can only be decided by micro-cultures.

Four Typhoid-like Bacilli isolated from Thames Mud.*—Dr. A. C. Houston describes four bacilli which were isolated from Thames mud, and gives a pictorial diagram showing their relation, as regards their chief morphological and biological characters, to one another, and also to some other allied organisms. The four bacilli are distinguished by the letters A B C D. Their chief characteristics are three or more flagella; no acidity and no clot in litmus-milk culture, at 37°; no gas development in gelatin shake-cultures. Their chief differences are that B exhibited diffuse cloudiness with a faint scum in phenol broth at 37°, while the growth of A C D was flocculent with varying amount of scum. A and C gave a trace of indol. All were actively motile. In size and shape they were much the same as *B. typhosus*, but if anything rather larger. None of them gave the Widal reaction.

The diagram might be used by bacteriologists with advantage.

Wet Rot in Potato.†—Herr C. Wehmer expresses the opinion that the wet rot of the potato is not an infective bacterial disease, but is directly due to certain environmental conditions, bacteria playing only a secondary part. His experiments show that potatoes placed in moisture, though exposed to aerial and contact infection, remain free from wet rot if the vessel be left uncovered. If, however, the vessel be covered over, the tubers will in a few days be affected with wet rot. When the environmental conditions are suitable, then bacterial agency is effective; and though it is possible that many bacteria may be able to produce the decomposition, yet there are two which are most frequently met with, viz. *Bacillus* i. and *Amylobacter Navicula*.

Influence of Lecithin on the Biology of Anthrax. — According to Herr W. Taranoukhine ‡ lecithin exerts considerable influence on the biology of the anthrax bacillus. The addition of pure lecithin or of substances containing lecithin, such as egg-yelk and calf's brain, to meat-pepton-agar, increases the growth. Pure lecithin aids the growth of the vegetative form of the virus and of the vaccine, and inhibits spore-formation. On the other hand, egg-yelk aids spore-production.

Boiling much diminishes the stimulating effect. In 20 per cent. brain-pepton-agar, the anthrax rodlet is but little enlarged, while the vaccine rodlet becomes 3–4 times as long as on simple meat-pepton and egg-yelk agar. When the virus is cultivated on brain-pepton-agar at 42·5°–43°, spores are freely formed in two or three days.

The author remarks that lecithin exerts a stimulating influence on tubercle, diphtheria, and some other bacteria.

* Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 518–25 (1 pl.).
† Ber. Deutsch. Bot. Gesell., xvi. (1898) pp. 172–7 (2 figs.).
‡ Russ. Arch. f. Pathol., vi. (1898). See Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) p. 896.

Prof. W. Podwyssotzky and M. W. Taranoukhine * have employed nutrient media containing lecithin, egg-yelk, or brain, for observations on plasmolysis as occurring in anthrax bacilli, in the bacterial sheath, and on brownian movements. They hold that they have definitely proved the presence of an enveloping membrane in bacteria, and that the influence of the cultivation medium, combined with the action of the incubation temperature, 42°–43°, cause the albuminous contents of the cell to cease to adhere to the sheath, which is therefore seen with surprising clearness. The contents of many of the cells exhibit lively movements which are brownian in character.

In the course of a few days the cultures exhibited masses of spores, which increased *pari passu* with the destruction of the bacterial filaments. The anthrax spore is produced entirely at the expense of the protoplasm, the sheath taking no part in its formation.

The foregoing phenomena are observed only when the medium contains both cerebral matter and pepton. If either or both be suppressed, the clearness of the capsule disappears, and the phenomenon of plasmolysis, which consists in a disintegration of the bacterial plasma into very small granules, is only occasionally witnessed.

Two Bacteria concerned in the Ripening of Cheese.† — Dr. H. Weigmann describes in detail the morphological and cultural characters of two bacteria previously alluded to by him in an article on the association of bacteria and cheese ripening. These two bacteria, presumably in symbiosis, produce a cheesy odour resembling that of Limburg cheese.

Bacterium *a* (*Clostridium licheniforme*), is an aerobe which forms short rodlets with rounded or pointed ends, and also grows into filaments. It produces central and polar spores which are extremely resistant to heat. The single rodlet is covered with flagella and exhibits lively movements. Successful cultures were obtained on agar and gelatin, alone or mixed with grape-sugar, on potato, and in milk. Milk was coagulated, and a faint cheesy odour became perceptible.

Bacterium *b* (*Paraplectrum fœtidum*) was cultivated anaerobically, the most successful media being grape-sugar, agar, and milk. The individual rodlets vary in length from 2·6–14 μ, and in breadth from 0·6–1·3 μ. No flagella were demonstrable, and the bacteria did not stain by Gram's method. In milk, one end of the rodlet soon begins to swell, and by the third day the terminal thickening has become an obvious spore. The spores are 1·75–2·1 μ long, 0·9–1·0 μ broad. From the anaerobic milk cultures, a pungent odour like that of over-ripe Limburg cheese arises.

Bacterium *a* belongs to the group of œdema-bacilli, or to that of symptomatic anthrax and butyric acid bacilli. The anaerobic bacterium *b* belongs in part to the symptomatic anthrax and butyric acid group, and in part to the tetanus group.

Fish Disease caused by Bacterium vulgare.‡—Herr O. Wyss describes a malady of fish in the Lake of Zurich. In *Leuciscus rutilus*,

* Ann. Inst. Pasteur, xii. (1898) pp. 501–9 (1 pl.); and Russ. Arch. f. Pathol., v. (1898) p. 653.

† Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 820–34 (2 pls., 16 figs.).

‡ Zeitschr. f. Hygiene u. Infektionskr., xxvii. (1898) pp. 143–74. See Bot. Centralbl., 1898, Beih., p. 83.

dead of this disease, numerous micro-organisms were found in the blood. Morphologically they were diplococci, diplobacilli, and short and long rodlets. All these belonged to one species, and only one microbe could be cultivated from the blood. The same microbe was also found in the pericardial fluid, in the bile, liver, muscles, and intestinal contents. The microbe, which was cultivated in the ordinary media, was found to be pathogenic, not only to fish, but also to rabbits, guinea-pigs, and mice.

The blood of healthy specimens of *Leuciscus rutilus* was found to be free from bacteria. The microbe is identical with *Bacterium vulgare* and *Proteus vulgaris*.

No special contamination of the lake water before or at the time of the epizootic was discovered, though the water-level was low and the temperature high.

Relation of the Toxin and Antitoxin of Snake Venom.*—Dr. C. J. Martin, in a supplementary paper, confirms the conclusions previously arrived at by him, that the antagonism between the toxins and antitoxins is a directly chemical one, and is not due to an interaction solely produced by the agency of the cells of the organism into which these substances enter. The present experiments were made with the venom of *Hoplocephalus curtus*; the antivenene was prepared by Calmette, and rabbits were used for the experiments. It was found that about the same quantity of antivenene necessary to neutralise the venom *in vitro* has the same effect when the former is injected into the blood-stream and the latter subcutaneously. When, however, venom and antivenene are introduced simultaneously and subcutaneously, it requires ten to twenty times the quantity of antivenene to neutralise the toxin. The explanation of the slower diffusion of the antitoxins offered is that their molecule is of larger size than that of the native proteids, and hence diffuses through membranes slowly as compared with the toxin, the molecule of which, though large, is less than that of the proteid.

Generalisation of Diphtheria Bacilli.†—Dr. Métin records experiments which appear to show that the diphtheria bacillus ((Loeffler) does not multiply in the viscera when it alone has been introduced into the organism. If it be found in the blood and organs, then its presence is due to association with other microbes, e.g. *Streptococcus* and *Staphylococcus*, or to a late post-mortem examination.

Gonococcus in the Blood.‡—Dr. P. Colombini records a remarkable case of generalised gonorrhœal infection, in which the *Gonococcus* was detected in the blood as well as in several abscesses.

Bacteriology of Trachoma.§—Herr L. Müller has succeeded in cultivating a bacillus from the conjunctival discharge of a case of trachoma. The microbe was morphologically and culturally identical with the influenza bacillus. It is a delicate rodlet which will grow only on substrata containing blood. A positive result was obtained in 11 out of 15 cases. In other forms of conjunctivitis the results were negative.

* Proc. Roy. Soc., lxiv. (1898) p. 88. See Nature, lix. (1898) p. 186. Cf. this Journal, 1898, p. 623.

† Ann. Inst. Pasteur, xii. (1898) pp. 596–603.

‡ Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 955-63

§ Wiener Klin. Wochenschr., 1897, No. 42. See Bot. Centralbl., 1898, Beih. p. 144.

Bacillus having the Tinctorial and Morphological Characters of Tubercle Bacillus.*—Herr Moëller states that he has found an organism on Timothy grass (used as fodder for horses) and in cow-dung, which has the same shape and staining reaction as the human tubercle bacillus. The cows did not react to tuberculin. The same bacillus was also found in the evacuations of goats, pigs, and horses. It frequently forms filaments with bulbous swellings, but never branches. When injected intraperitoneally into guinea-pigs, severe lung mischief with breaking down of the pulmonary tissue ensued.

Bacillus Dysenteriæ.†—Dr. K. Shiga describes a bacillus which he has isolated from the dejecta in 34 cases of dysentery, and has also found in the intestinal wall and mesenteric glands of two cases dead of the disease. It is a short rodlet with rounded ends, and has much resemblance to the typhoid bacillus. It exhibits the agglutination phenomenon when acted on by the blood-serum of persons suffering from dysentery. When introduced into the stomach of cats and dogs, it excites in 1–2 days a diarrhœa with loose mucoid motions. The author expresses hopes that he will be able to prepare an effective curative serum, as experiments made on himself lead him to this expectation.

Bacillus anthracis similis.‡—Prof. J. McFarland describes an organism isolated from the pus of an abscess, the colonies of which were identical with those of *B. anthracis*. It is a large bacillus with slightly rounded ends, and forms long filaments with transverse septa. The filaments form parallel wavy bundles, and in the older parts of the growth numerous oval endogenous spores were observed. In bouillon cultures four days old there were no spores, but in agar cultures three weeks old there was scarcely anything else but spores.

Agar and gelatin cultures are precisely similar to those of *B. anthracis*. On bouillon there forms a surface mycoderm and a sediment from constantly precipitating bacillary masses. In a few days the surface scum sinks, leaving the supernatant fluid clear. The growth on potato is luxuriant. *B. anthracis similis* is non-pathogenic to guinea-pigs, mice, or rabbits.

Bacillus luteus sporogenes.§—Mr. R. F. Wood Smith and Mr. J. L. Baker have separated this bacillus from two different samples of beet-root sugar. It is a long endosporogenous bacillus, growing with great rapidity in all the ordinary artificial nutrient media, with the formation of a yellow pigment. The agar cultures exhale an odour resembling impure acetamide and some other amido compounds. Gelatin is slowly liquefied. The organism is 4–5 μ long, highly motile, and possessed of from 2–4 lateral flagella. These flagella are eight or nine times as long as the bacilli themselves, and are peculiar on account of their straightness and freedom from the undulating form of most flagella. The organism stains readily with the usual anilin solutions, and also by Gram's method. The spores stain well with hot phenol-fuchsin.

* Berlin. Tierärztl. Wochenschr., 1898, p. 100. Deutsche Med. Wochenschr., 1898, No. 24. See Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 844–5.

† Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 817–28, 870–4, 913–8 (4 figs.).

‡ Tom. cit., pp. 556–7.

§ Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 788–9 (2 figs.).

Varieties and Virulence of Pneumococcus.*—Dr. J. W. Eyre and Dr. J. W. Washbourn are of opinion that there are types of *Pneumococcus* which differ from one another in virulence and in biological characters; and their recent investigations show that in describing varieties of the *Pneumococcus*, besides the biological characters and the initial virulence, the power of acquiring and of retaining a high degree of virulence must be taken into account. These recent observations deal with four races of *Pneumococcus*, three of which were derived from pathological lesions in the human subject. In these there was about the same initial virulence; the standard virulence (i.e. 0·000001 of a loop, holding about half a milligram), fatal within 48 hours, was attained in less than a dozen passages, and it was maintained for a considerable period. The fourth variety was obtained from the saliva of a healthy man. From the others it differed in its capability of growing at 20° C., in the fact that while its initial virulence was not less than that of the other races, there was great difficulty in raising it to the standard, and in that after the standard virulence had been reached, it very quickly diminished. In fact, this particular race, which had been living a saprophytic existence, possessed a low capacity for retaining a high degree of virulence, while the other three parasitic races possessed great capabilities for acquiring and retaining a high degree of virulence.

Infective Sarcomata in Dogs.†—Mr. G. B. Smith and Dr. J. W. Washbourn, who have already described their experiments dealing with infective tumours on the genitals of dogs, give an account of a series of inoculations into the subcutaneous tissue. Out of 17 inoculations, 4 were unsuccessful; while in the remaining 13 definite tumours developed. The malignant character of the growth is shown by the secondary deposits in the internal viscera. The growths presented the usual characters of a round-celled sarcoma, and no inflammatory appearances were made out in the actively growing tumours. The authors claim that they have shown that these infective round-celled sarcomata affecting the genitals of dogs can be transplanted from their natural site to the subcutaneous tissue of other dogs, and from the latter through a series of dogs.

They have also observed that when these tumours attain their maximum growth, which usually occurs in about three months, they may disappear spontaneously, with or without ulceration. If the tumour disappear, the animal is then immune to subsequent vaccination.

Smegma Bacillus in Human Sputum.—Herr Pappenheim ‡ records a case which was diagnosed as tuberculosis owing to the presence of red-stained rodlets in the sputum when treated by Gabbet's method. There were, however, no pulmonary physical signs. From their shape and arrangement, and from the decolorising action of alcohol, the author believes that these rodlets were not tubercle but smegma bacilli, or some closely allied variety.

Herr A. Fraenkel § has repeatedly observed, in cases of pulmonary

* Lancet, 1899, i. pp. 19–22.
† Brit. Med. Journ., 1898, ii. pp. 1807–11 (2 figs.).
‡ Berlin. Klin. Wochenschr., 1898, p. 809. See Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 699–700.
§ Tom. cit., p. 880.

gangrene, pseudo-tubercle bacilli in the sputum. He regards these as saprophytes belonging to the smegma bacillus group. He suggests that the reason why these bacilli give the specific staining reaction, is the presence of fatty substances in the sputum; for it is well known that many bacteria, when cultivated in a fatty medium, become resistant to acid. In cases where it is suspected that the bacteria may be pseudo-tubercle bacilli, cultivations and other staining methods should be resorted to.

Bacillus ferrugineus.*—Dr. W. Rullmann describes a chromogenic bacillus which was isolated from canal water. Plate cultures were stained a rusty brown colour. In solid media the pigment was generally diffused throughout the mass. In liquid media the pigment was formed near the surface. The reaction of the cultures was strongly alkaline. Like some other bacteria, its morphological characters varied somewhat with the media. On sugar bouillon it was $0 \cdot 8\ \mu$ broad by $2 \cdot 0$–$2 \cdot 2\ \mu$ long, and there was no polar staining. On potato it was $0 \cdot 5\ \mu$ broad by $1 \cdot 4\ \mu$ long, and the polar staining was well marked. In Winogradsky's solution it formed a distinct capsule. On nitrit-agar its size was much diminished. Cultivated at 37° on meat-agar without pepton, involution forms were frequent and of large size. In hanging drops lively movements were observed. The pigment was found to be only slightly soluble in water and ordinary alcohol, but very soluble in alkaline or acid alcohol; the evaporated residue was then very soluble in water.

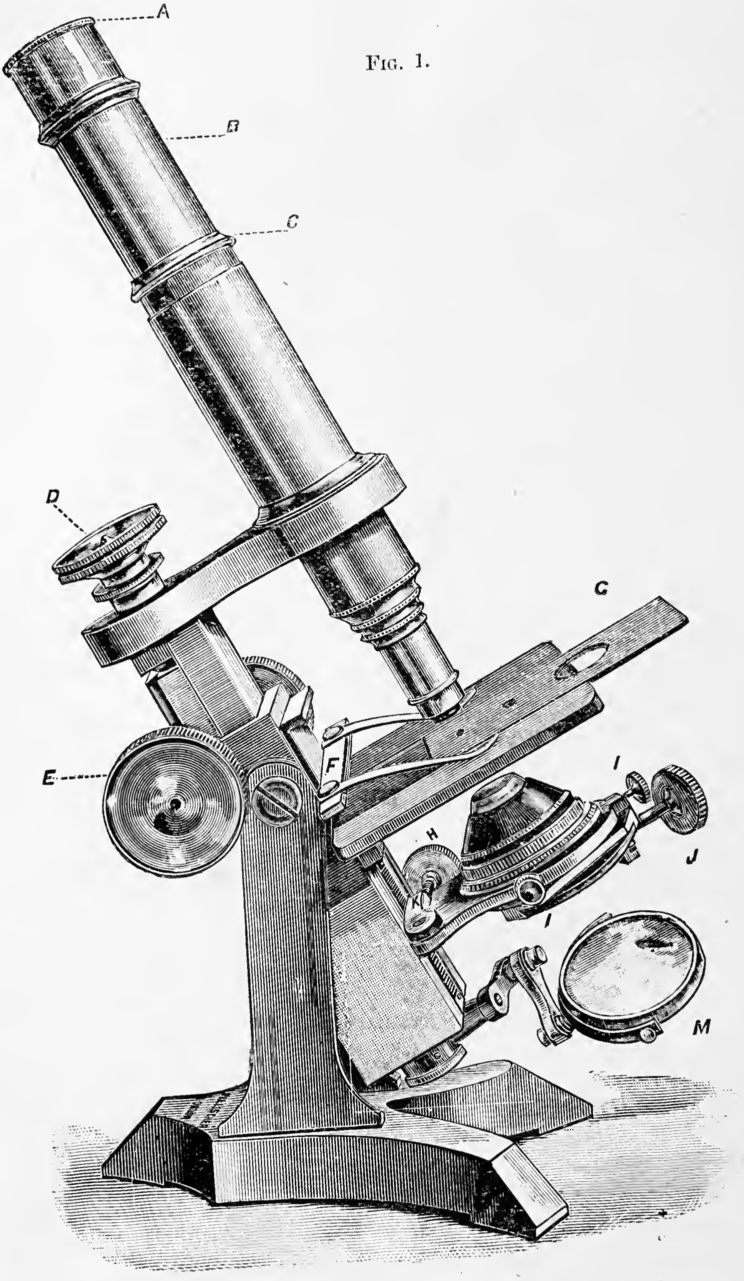
There was little characteristic in the shape of the individual colonies, but the superficial ones were browner than those lying deeper. The bacillus possesses a peptonising action. It is not pathogenic to mice.

Hewlett's Bacteriology.†—Dr. R. T. Hewlett's 'Manual of Bacteriology' is eminently suited to the wants of those interested in clinical medicine and hygiene, and for laboratory work. By the omission of superfluous details and duplicate processes of secondary value, sufficient space has been obtained for more urgent and important subjects, such as preparation of tissues, methods of culture, description and detection of pathogenic organisms, bacterial remedies, &c., which are discussed with desirable fulness. The first chapter deals shortly with the classification, biology, and chemistry of bacteria, and their relation to disease. The next three chapters are devoted to the preparation of tissues and organisms, the cultivation and isolation of organisms, and the investigation of microbial diseases. In chapter v. the interesting and important question of immunity is discussed with considerable care and clearness. In the next ten chapters are described the various pathogenic bacteria; and following these are accounts of the Blastomycetes, Hyphomycetes, the Protozoa, some diseases of uncertain origin, and certain microbes affecting the skin and mucosas. The last chapters deal with the bacteriology of water, air, and soil; of milk and foods; with antiseptics and disinfectants; and with bacterial remedies, such as the antitoxins of diphtheria, Streptococcus, Pneumococcus, tetanus; with tuberculin, mallein, anti-cholera and anti-typhoid vaccine, and Coley's fluid.

* Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 465–7.
† London, J. and A. Churchill, 1898, vi. and 439 pp., 73 figs.

Though some subjects are discussed more fully than others of no less importance, it must be admitted that on the whole this manual of bacteriology is better balanced than many other works on the subject; and it is pleasing to note that the author has indicated the rightful pioneers in several well known instances of bacteriological research, where previous writers have gone astray. To workers in the bacteriological or clinical laboratory this manual of bacteriology may be cordially recommended.

Fig. 1.



MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

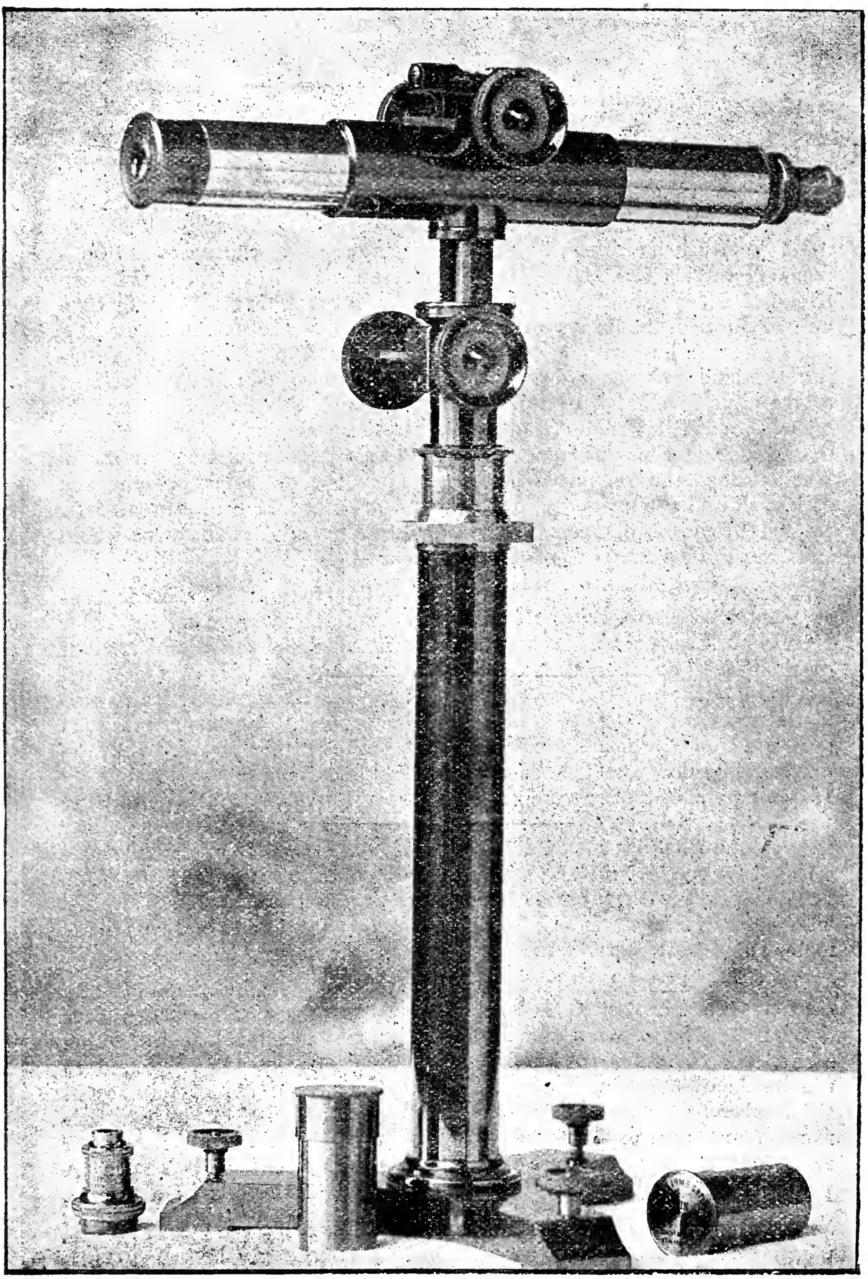
Pillischer's International Microscope.—This instrument (fig. 1) has the Continental length of tube when the joint B is drawn out; hence the title of "International." The pillar worked by the coarse adjustment E carries the fine adjustment D, and the two adjustments are therefore independent. C is a milled rim for pushing the whole tube up and down in its sleeve. A notable feature is the device for raising and lowering the spring clips, which are screwed to a bar F, thus forming a framework secured to a vertical slide flanged; the adjustment of the clips is effected by raising or depressing this flange. The stage has a thin sliding plate G pierced with three apertures for regulating the light, and the substage condenser has an iris and ring for stops. The substage can be placed excentrically to the optical axis by means of a rack and pinion operated by the milled head H, and can also be rotated by means of the milled head J. A pivot K enables the whole substage to be swung out of use.

Barnes' Horizontal Microscope.—This instrument (fig. 2) is constructed by Messrs. Bausch and Lomb from the designs of Professor Barnes of Wisconsin University, and is intended for the direct reading of the growth or movements of plant organs, &c. It will also be found useful in many other lines where a Microscope is required in a horizontal position. It consists of a nickelled tube with Society screw. An accurate spirit-level is attached, its axis being exactly parallel with the axis of the Microscope. Vertical adjustment is quickly effected by loosening the clamping ring shown near the top of the stand, permitting the Microscope-tube to be raised about 200 mm., or clamped at any intermediate point. The final vertical setting of the instrument is effected by vertical rack and pinion having movement of 75 mm. The base is fitted with three levelling screws for horizontal adjustment. The eye-piece is of 1-inch focus, and is furnished with a disc micrometer ruled to tenths of a millimetre across the entire field.

Improved Excelsior Dissecting Microscope.—This instrument (fig. 3), sold by Messrs. Bausch and Lomb, consists of a small wooden case 4 by 2 by $1\frac{1}{2}$ in. One end of the case is attached to the lid, which serves as a cover for the whole. A steel rod, $3\frac{3}{4}$ in. long, is fitted to the inside of the box, at one side of it, thus being out of the way of the forehead when focussing high- or low-power lenses. Rubber magnifiers of one, two, or three lenses, giving a range of magnifying power from 5 to 25 diameters, are arranged for adjustment on this rod. A plane mirror $2\frac{1}{4}$ by $1\frac{1}{4}$ in. is fitted to one end of the box in a groove,

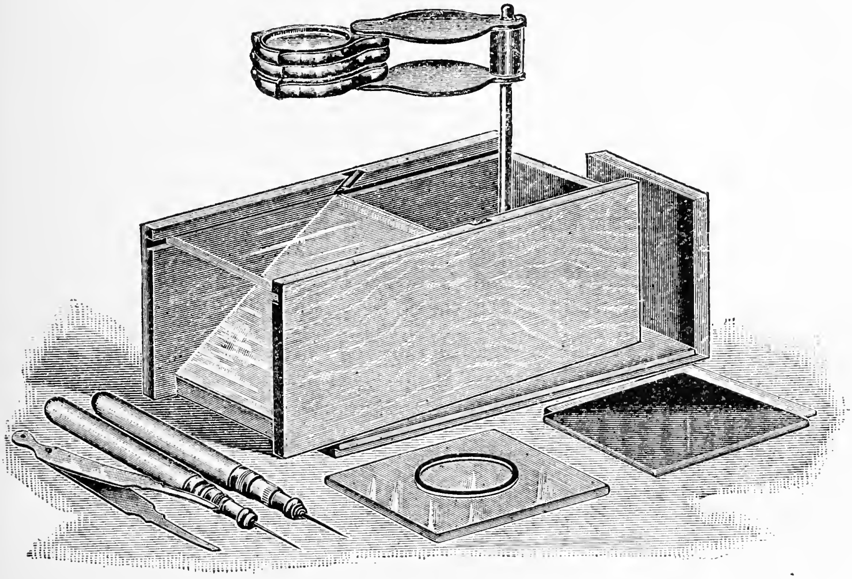
* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

Fig. 2.



giving the proper angle. A glass stage $1\frac{5}{8}$ by $1\frac{3}{4}$ in. is adjustable in a groove near the top of the box, and can be replaced by a glass stage with cell, opal glass stage, or black glass stage, of the same size.

FIG. 3.

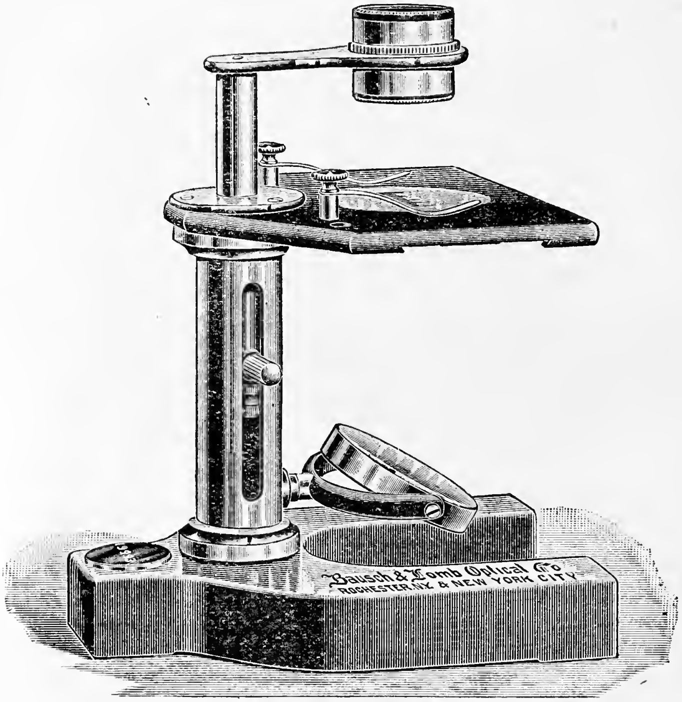


Bausch and Lomb's Educational Dissecting Microscope. — The popularity of this instrument has induced the makers to bring out an improved form (fig. 4). The base is of japanned metal, very heavy to secure stability. All other parts are heavily nickelled to prevent erosion by reagents. The stage is of large size, and the opening is provided with a glass disc. The lenses are carried by a metal arm movable about the stage, and are focussed by means of the knob shown at the side of the pillar, this method being entirely satisfactory for lenses of the powers used. Triplet, Coddington, or doublet lenses are supplied, but the two first are recommended on account of their superior defining power.

Improved Stage Construction. — Messrs. Bausch and Lomb have been paying special attention to this part of the instrument, and consider that their new stages are exactly at right angles to the optical axis, perfectly rigid under manipulation, possess perfectly plane surfaces, and are not affected by reagents. The surfaces of all stages, except in the cheaper stands, are of hard rubber. The metal part of the stage is recessed and covered with beaded studs. The rubber is forced into this depression while in a plastic condition, and vulcanised in such a manner that not only a mechanical but a chemical union takes place between the rubber and the metal. This form of stage will never warp, as plates applied with screws will do, and retains its finish indefinitely.

Figs. 5 and 6 show how an iris diaphragm is used in the plane of the stage, either with or without the condenser, so as to give any desired size of aperture, even sufficient for the condenser to be used *through* it in oil-immersion contact with the slide if desired. The advantage of such a diaphragm is apparent, as it is thus in the only position at which the volume of light entering the objective can be varied without changing the aperture of the illuminating cone. Two forms have been

Fig. 4.



adopted: for some stands, a shallow mounting which screws to the underside of the stage and forms a part of it (fig. 6); and for all instruments provided with the complete substage, a deeper detachable form (fig. 7), A being the ring by which the diaphragm is operated.

Microscope with a New Mechanical Stage.—The accompanying figure (fig. 8) represents a Microscope made by Messrs. Watson and Sons, having a new form of mechanical stage designed by Mr. E. M. Nelson. The mechanism of the stage has been described in this Journal, 1888, p. 477, 1893, p. 236, and 1897, p. 185, with working drawings; but as yet no woodcut of the Microscope itself has appeared.

Bausch's New Microscope Stand.* — Mr. Edward Bausch has invented this stand (fig. 9) with the object of producing for school use

Fig. 5.

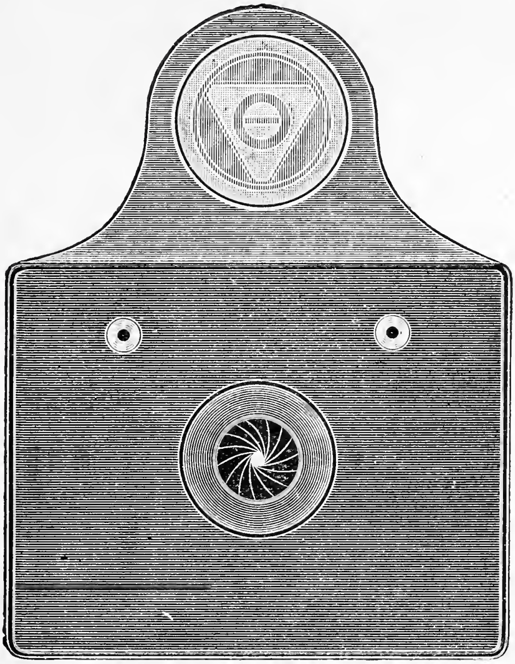
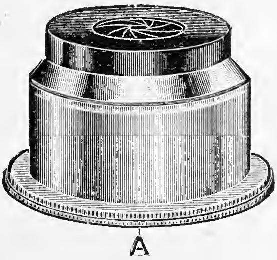


Fig. 6.

Fig. 7.

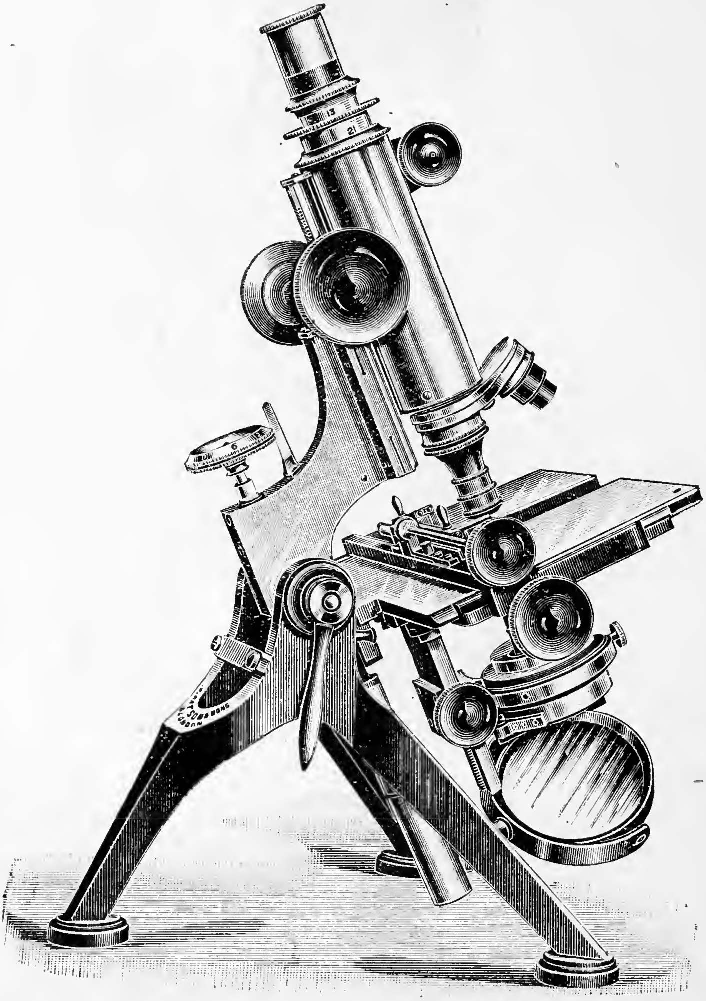


an article which shall combine both simplicity and cheapness of construction, and yet be a scientific instrument and not a toy. The coarse

* Journ. of Applied Micr., 1898, pp. 110–11 (1 fig.).

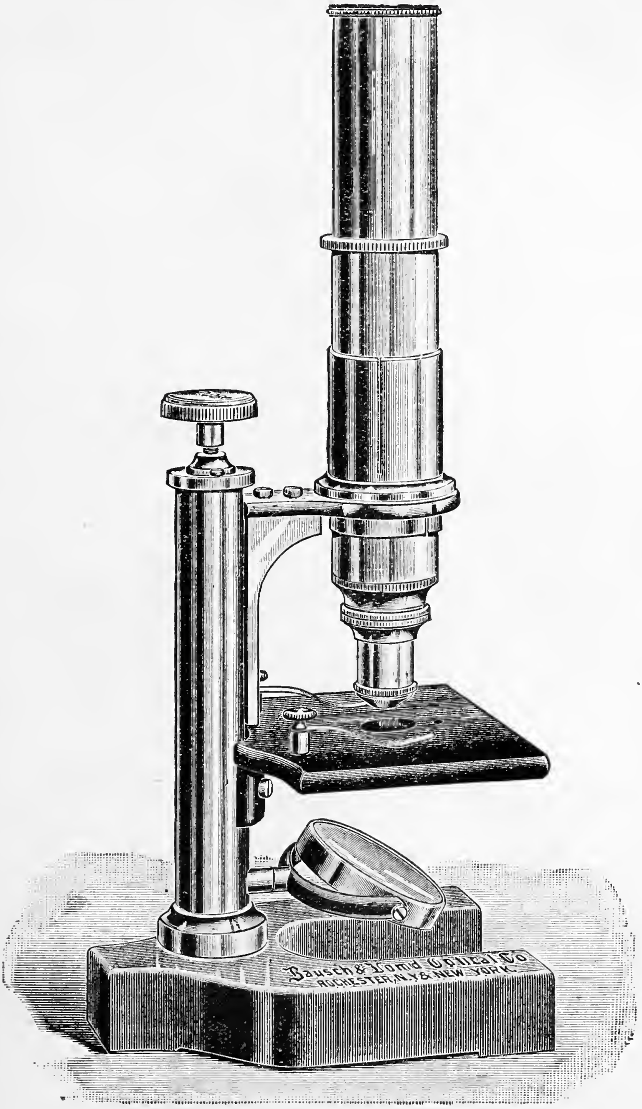
adjustment is attained by sliding the tube, and the fine by a micrometer screw. The qualities of a perfect fine adjustment are delicacy, rigidity, and permanency. Mr. Bausch considers that the European is generally admitted to be the best, but that its use in any simple instrument is

Fig. 8.



precluded on account of its considerable cost. He considers, however, that his form of fine adjustment proves an excellent substitute. The instrument to which he has applied it has a small japanned iron base, the pillar and arm is a single brass rod 7/8 of an in. in diameter, in the upper half of which is recessed a V-way with a T cross-cut, to which the arm is fitted. This combines extreme rigidity with compactness.

Fig. 9.



Recessed into the lower end of the pillar is a spring which forces the arm upward against a micrometer-screw which is attached to the upper extremity of the rod. In the lower end of the screw a hardened steel pin is recessed so that eccentricity of the screw cannot possibly be conveyed to the arm. Attached to the arm is a plate which receives the sleeve-tube in which the body-tube carrying the eye-piece and objective slides. The body-tube is of standard size, and of fixed length of 160 mm. The stage is fastened to the pillar rigidly, is of liberal proportions, and is provided with a revolving diaphragm. The dimensions of the instrument are as follows:—total length with objective and eye-pieces attached ready for use, 11 in.; stage, $3\frac{3}{4} \times 3\frac{3}{8}$ in. The outside dimensions of the case are 11 in. high, $4\frac{1}{2}$ in. wide, $5\frac{1}{2}$ in. deep. The inventor speaks highly of the portability and working qualities of the instrument, as well as of its suitability for school use.

(2) Eye-pieces and Objectives.

Formulæ for Small-Apertured Objectives.*—Dr. H. Harting summarises the formulæ which have been developed by him elsewhere. They refer to the radii of a two-membered cemented objective of given qualities of glass, and are constructed for water- and dry-immersions.

σ_1 = the reciprocal of the working distance.

σ'_3 = the reciprocal of the focal distance from the last surface.

n_0 = refraction coefficient of immersion (in dry systems = 1).

n_1, n_2 = the refraction coefficients of the first and second lenses, calculated with reference to the D line.

$d\,n_0, d\,n_1, d\,n_2$ = corresponding dispersions between lines C and F.

Then

$$N_1 = \frac{d\,n_1}{n_1} - \frac{d\,n_0}{n_0}. \qquad L_1 = \frac{1}{n_1} - \frac{1}{n_0}.$$

$$N_2 = \frac{d\,n_2}{n_2} - \frac{d\,n_1}{n_1}. \qquad L_2 = \frac{1}{n_2} - \frac{1}{n_1}.$$

$$N_3 = \quad - \frac{d\,n_2}{n_2}. \qquad L_3 = 1 - \frac{1}{n_2}.$$

$$s = \sigma_1 - \sigma'_3.$$

$$a_1 = + \epsilon \frac{N_2}{N_2 L_1 - N_1 L_2}. \qquad b_1 = \frac{N_3 L_2 - N_2 L_3}{N_2 L_1 - N_1 L_2}.$$

$$a_2 = - \epsilon \frac{N_1}{N_2 L_1 - N_1 L_2}. \qquad b_2 = \frac{N_1 L_3 - N_3 L_1}{N_2 L_1 - N_1 L_2}.$$

$$h_1 = L_1 \left(\sigma'_3 + L_2 a_2 - \frac{a_1}{n_0}\right). \qquad k_1 = L_1 \left(L_3 + L_2 b_2 - \frac{b_1}{n_0}\right).$$

$$h_2 = L_2 \left(\sigma'_3 - \frac{a_2}{n_1}\right). \qquad k_2 = L_2 \left(L_3 - \frac{b_2}{n_1}\right).$$

$$h_3 = L_3\, \sigma'_3. \qquad k_3 = - \frac{L_3}{n_2}.$$

* Zeitschr. f. Instrumentenk, 1898, pp. 331–5.

$$A = b_1' k_1 + b_2 k_2 + k_3.$$
$$B = b_1 h_1 + b_2 h_2 + h_3 + a_1 k_1 + a_2 k_2.$$
$$C = a_1 h_1 + a_2 h_2.$$
$$A' = b_1^2 k_1 + b_2^2 k^2 + k_3.$$
$$B' = b_1^2 h_1 + b_2^2 h_2 + h_3 + 2 a_1 b_1 k_1 + 2 a_2 b_2 k_2.$$
$$C' = a_1^2 k_1 + a_2^2 k_2 + 2 a_1 b_1 h_1 + 2 a_2 b_2 h_2.$$
$$D = a_1^2 h_1 + a_2^2 h_2.$$
$$S_1 = A Q_3^2 + B Q_3 + C.$$
$$S_2 = A' Q_3^3 + B' Q_3^2 + C' Q_3 + D'.$$

S_2 is to be equated to zero and the cubic equation for Q_3 solved, as the spherical aberration along the axis is *nil*. By suitable selection of the proper kinds of glass S_1, the expression for the satisfaction of the sine law can be indefinitely small. Along with the values of Q_3 got by equating either $S_1 = 0$, or $S_2 = 0$, there must be taken

$$Q_1 = a_1 + b_1 Q_3. \qquad f_1 = h_1 + k_1 Q_3.$$
$$Q_2 = a_2 + b_2 Q_3. \qquad f_2 = h_2 + k_2 Q_3.$$
$$f_3 = h_3 + k_3 Q_3.$$

And for control,

$$S_1 = \Sigma Q_\kappa f_\kappa. \qquad S_2 = \Sigma Q^2_\kappa f_\kappa.$$

$$\sigma_3 = \sigma'_3 + \frac{n_2 - 1}{n_2} Q_3.$$

$$\sigma_2 = \sigma'_3 + \frac{n_2 - 1}{n_2} Q_3 + \frac{n_1 - n_2}{n_1 n_2} Q_2.$$

$$\sigma_1 = \sigma'_3 + \frac{n_2 - 1}{n_2} Q_3 + \frac{n_1 - n_2}{n_1 n_2} Q_2 + \frac{n_0 - n_1}{n_0 n_1} Q_1.$$

$\frac{1}{\sigma_\kappa}$ with regard to $\frac{1}{\sigma'_\kappa}$ is the distance of the intersection point of the ray refracted from the $(\kappa - 1)$th to the κth surface with the axis, and is measured from the vertex of the κth surface.

If ρ_1, ρ_2, ρ_3 are the reciprocals of the radii r_1, r_2, r_3, then

$$\rho_1 = \frac{1}{r_1} = \frac{Q_1}{n_0} + \sigma_1.$$

$$\rho_2 = \frac{1}{r_2} = \frac{Q_2}{n_1} + \sigma_2.$$

$$\rho_3 = \frac{1}{r_3} = \frac{Q_3}{n_2} + \sigma_3.$$

Controlling equations for h and k are

$$h_1 + h_2 + h_3 = \sigma'_3 - \frac{\sigma'}{n_0}.$$

$$k_1 + k_2 + k_3 = 0.$$

In the case of a dry system $n_0 = 1$, and

$$N_1 + N_2 + N_3 = L_1 + L_2 + L_3 = 0.$$
$$b_1 = b_2 = +1.$$
$$A' = A = 0.$$

And the reciprocal focal distance ϕ comes from

$$\phi = \frac{n_1 - 1}{n_1}(Q_1 - Q_2) + \frac{n_2 - 1}{n_2}(Q_2 - Q_3).$$

In order to pass from a system of infinitely thin lenses calculated as above to a system with finite thickness, one must calculate a paraxial ray passing through selected thicknesses d_1 and d_2 with ascertained radii, and form the expressions

$$\overline{Q}_\kappa = n_{\kappa-1}(\rho_\kappa - \sigma_\kappa) = n_\kappa(\rho_\kappa - \sigma'_\kappa).$$

$$\overline{\Gamma} = \sum_1^3 \left(\frac{h_\kappa}{h_1}\right)^2 Q_\kappa \left(\frac{d\,n_\kappa}{n_\kappa} - \frac{d\,n_{\kappa-1}}{n_{\kappa-1}}\right).$$

$$\overline{S}_1 = \sum_1^3 \left(\frac{h_\kappa}{h_1}\right)^3 Q_\kappa \left(\frac{\sigma'_\kappa}{n_\kappa} - \frac{\sigma_\kappa}{n_{\kappa-1}}\right).$$

$$\overline{S}_2 = \sum_1^3 \left(\frac{h_\kappa}{h_1}\right)^4 Q^2_\kappa \left(\frac{\sigma'_\kappa}{n_\kappa} - \frac{\sigma_\kappa}{n_{\kappa-1}}\right).$$

Whence

$$\frac{h_\kappa}{h_1} = \frac{\sigma'_{\kappa-1}}{\sigma_\kappa} \cdot \frac{\sigma'_{\kappa-2}}{\sigma_{\kappa-1}} \cdot \cdot \cdot \cdot \frac{\sigma'_1}{\sigma_2},$$

and $\overline{\sigma}$, $\overline{\sigma}'$, $\overline{Q}$ are taken from the calculation of the paraxial ray.

$\overline{\Gamma}$, the expression of the chromatic aberration and $\overline{S}_2$ are no longer zero, whilst $\overline{\sigma}'_3$ becomes considerably greater than the σ'_3 belonging to the general calculation. Now with the values $\overline{Q}$ and $\overline{\sigma}$ taken from the through-calculation, the following equations are built up:

$$\frac{\delta\,\sigma'_3}{\delta\,Q_1} = \left(\frac{1}{n_0} - \frac{1}{n_1}\right)(1 + 2\,d_1\,\sigma_2 + 2\,d_2\,\sigma_3).$$

$$\frac{\delta\,\sigma'_3}{\delta\,Q_2} = \left(\frac{1}{n_1} - \frac{1}{n_2}\right)(1 + 2\,d_2\,\sigma_3).$$

$$\frac{\delta\,\sigma'_3}{\delta\,Q_3} = \frac{1}{n_2} - 1.$$

$$\frac{\delta\,\Gamma}{\delta\,Q_1} = N_1 - 2\left[d_1\,Q_2\,N_2 + (d_1 + d_2)\,Q_3\,N_3\right]\left(\frac{1}{n_0} - \frac{1}{n_1}\right).$$

$$\frac{\delta\,\Gamma}{\delta\,Q_2} = N_2(1 - 2\,d_1\,\sigma_2) - 2\,d_2\,Q_3\,N_3\left(\frac{1}{n_1} - \frac{1}{n_2}\right).$$

$$\frac{\delta\,\Gamma}{\delta\,Q_3} = N_3(1 - 2\,d_1\,\sigma_2 - 2\,d_2\,\sigma_3).$$

$$\frac{\delta S_2}{\delta Q_1} = \left(\frac{1}{n_0} - \frac{1}{n_1}\right)\left\{\frac{3 Q_1^2}{n_1} - 2 Q_1 \sigma_1 - Q_2^2\left(\frac{1}{n_1} - \frac{1}{n_2}\right) - Q_3^2\left(\frac{1}{n_2} - 1\right)\right.$$

$$+ 8 d_1 \sigma_2 Q_2^2\left(\frac{1}{n_1} - \frac{1}{n_2}\right) + 4 d_1 \sigma_2 Q_3^2\left(\frac{1}{n_2} - 1\right)$$

$$+ 8 d_2 \sigma_3 Q_3^2\left(\frac{1}{n_2} - 1\right) - 4 d_1 \frac{Q_2^3}{n_2}\left(\frac{1}{n_1} - \frac{1}{n_2}\right)$$

$$\left. - 4(d_1 + d_2)\left(\frac{1}{n_2} - 1\right) Q_3^3 + 4 d_1\left(\frac{1}{n_2} - 1\right)\sigma_3 Q_3^2\right\}.$$

$$\frac{\delta S_2}{\delta Q_2} = \left(\frac{1}{n_1} - \frac{1}{n_2}\right)\left\{\left[\frac{3 Q_2^2}{n_2} - 2 Q_2 \sigma_2 - Q_3^2\left(\frac{1}{n_2} - 1\right)\right](1 - 4 d_1 \sigma_1)\right.$$

$$\left. + 8 d_2 \sigma_3 Q_3^2\left(\frac{1}{n_2} - 1\right) - 4 d_2 Q_3^3\left(\frac{1}{n_2} - 1\right)\right\}.$$

$$\frac{\delta S_2}{\delta Q_3} = \left(\frac{1}{n_2} - 1\right)\{3 Q_3 - 2 \sigma_2\} Q_3 (1 - 4 d_1 \sigma_2 - 4 d_2 \sigma_3).$$

These magnitudes occur as coefficients in the following equations:

$$\Delta Q_1 \frac{\delta \sigma'_3}{\delta Q_1} + \Delta Q_2 \frac{\delta \sigma'_3}{\delta Q_2} + \Delta Q_3 \frac{\delta \sigma'_3}{\delta Q_3} = \sigma'_3 - \bar{\sigma}'_3.$$

$$\Delta Q_1 \frac{\delta \Gamma}{\delta Q_1} + \Delta Q_3 \frac{\delta \Gamma}{\delta Q_2} + \Delta Q_3 \frac{\delta \Gamma}{\delta Q_3} = - \bar{\Gamma}.$$

$$\Delta Q_1 \frac{\delta S_2}{\delta Q_1} + \Delta Q_2 \frac{\delta S_2}{\delta Q_2} + \Delta Q_3 \frac{\delta S_2}{\delta Q_3} = - S_2.$$

From these the three quantities ΔQ are to be calculated, and, when added to the $\bar{Q}$, define the Q: wherefrom, as before, follow the new radii, which, combined with the assumed thicknesses, produce a system free from spherical and chromatic aberration at the given working distance and tube-length, and satisfying the sine law.

Example: $n_0 = 1$.

$n_1 = 1 \cdot 57332$. $d n_1 = + 0 \cdot 00998$ (heavy barium silicate crown).
$n_2 = 1 \cdot 62059$. $d n_2 = + 0 \cdot 01714$ (ordinary silica flint).

$\sigma_1 = - 0 \cdot 027778$.	$\sigma'_3 = + 0 \cdot 005556$.
$\log N_1 = 7 \cdot 8023$.	$\log L_1 = 9 \cdot 5616\, n$.
$\log N_2 = 7 \cdot 6265$.	$\log L_2 = 8 \cdot 2681\, n$.
$\log N_3 = 8 \cdot 0243$.	$\log L_3 = 9 \cdot 5831$.
$h_1 = + 0 \cdot 03307$.	$k_1 = + 0 \cdot 2319$.
$h_2 = - 0 \cdot 00185$.	$k_2 = + 0 \cdot 0047$.
$h_3 = + 0 \cdot 00213$.	$k_3 = - 0 \cdot 2366$.

$$a_1 = + 0\cdot 09904. \qquad a_2 = - 0\cdot 1485.$$
$$S_1 = + 0\cdot 05561\ Q_3 + 0\cdot 00355.$$
$$S_2 = + 0\cdot 07788\ Q_3^2 + 0\cdot 009479\ Q_3 + 0\cdot 0002835 = 0.$$

One root of the equation $S_2 = 0$ is $Q_3 = - 0\cdot 05293$, and

$$Q_2 = - 0\cdot 2014. \qquad r_1 = + 54\cdot 56.$$
$$Q_1 = + 0\cdot 04611. \qquad r_2 = - \ 7\cdot 195.$$
$$S_1 = + 0\cdot 0006072. \qquad r_3 = - 21\cdot 11.$$

On the assumption that $d_1 = + 1\cdot 5$, $d_2 = + 1\cdot 0$, we get from the working out of the paraxial ray $\overline{\sigma'}_3 = + 0\cdot 006176$, $\overline{\Gamma} = + 0\cdot 00001279$, $\overline{S}_2 = + 0\cdot 000001416$, and the correction-equations with logarithmic coefficients

$$+ 7\cdot 4042\ \Delta Q_1 + 7\cdot 1257\ \Delta Q_2 - 7\cdot 4325\ \Delta Q_3 = - 4\cdot 1511.$$
$$+ 7\cdot 7721\ \Delta Q_1 + 7\cdot 6383\ \Delta Q_2 - 8\cdot 0500\ \Delta Q_3 = - 5\cdot 1069.$$
$$+ 9\cdot 5343\ \Delta Q_1 + 8\cdot 2555\ \Delta Q_2 - 9\cdot 5832\ \Delta Q_3 = - 6\cdot 7928.$$

Whence

$$\Delta Q_1 = + 0\cdot 000893, \qquad Q_1 = + 0\cdot 04700.$$
$$\Delta Q_2 = + 0\cdot 00237, \qquad Q_2 = - 0\cdot 1993.$$
$$\Delta Q_3 = + 0\cdot 002529, \qquad Q_3 = - 0\cdot 05102.$$
$$\Gamma = + 0\cdot 00000029, \qquad S_2 = - 0\cdot 00000254.$$
$$r_1 = + 52\cdot 03.$$
$$r_2 = - \ 7\cdot 291.$$
$$r_3 = - 22\cdot 00.$$

A calculation of the rays proceeding from the object, and inclined to the axis at 6°, 4°, 2°, and infinitely slightly, gave

Ray.	Intersection distance.	Logarithmic sine ratio.
C-axis	180·39	0·6869
F-axis	189·37	0·6868
D-axis	179·93	0·6858
D 2°	179·98	0·6857
D 4°	180·67	0·6867
D 6°	184·17	0·6936
C 6°	183·72	0·6926
F 6°	187·78	0·7009

By a slight trigonometrical adjustment, the aberration residue can be rendered negligible. The calculation for the second root value of Q_3 is carried out similarly; finally, both evaluated systems have to be investigated in their relation to extra-axial rays.

Centering of Lenses.*—Dr. Hugo Schroeder commences his paper on this subject by pointing out the obvious importance of accurate central

* Central-Zeit. f. Optik, 1898, pp. 161–2, 172–3, 182–3.

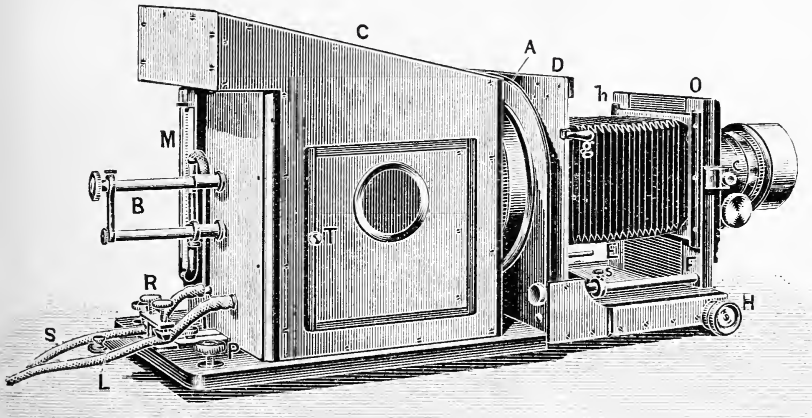
adjustment, and by expressing his surprise that so little is met with on the subject in optical treatises.

Faultless centering occurs when the thickest point of convex lenses (and the thinnest point of concave ones) lies in the centre of the circular periphery of the lens. Moreover, the line joining the two sphere-centres of the lens must be perpendicular to the two surfaces of the lens. A historical account of the means adopted by early opticians to attain these conditions is given. References are made to Prechtl's 'Praktische Dioptrik' (Wien, 1828), to Robert Smith's 'Optics' (1755), to Klügel (Wien, 1765), and to Fraunhofer's methods. It appears that Fraunhofer published nothing on centering, but the author has met with a traditional account of his manner of working. The paper contains (p. 173) an account of the method of centering large flattish lenses adopted by Ross.

(3) Illuminating and other Apparatus.

Behrens' New Projection Apparatus.*—Prof. Behrens' object was to produce an apparatus cheap, handy, portable, which should serve all but the highest purposes of demonstration. After discussing the advantages and disadvantages of the various luminants, he selects lime-light as the best for general use, but points out that the usual burner is faulty, and describes his design for improving it.

Fig. 10.

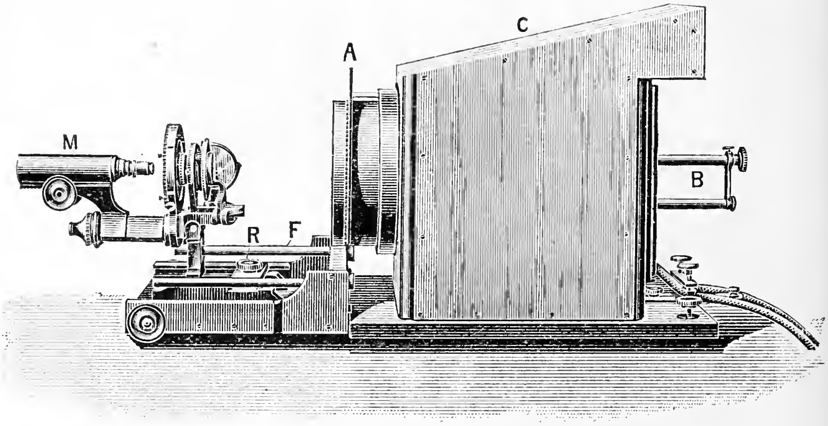


The general arrangement of the apparatus is shown in figs. 10 and 11. The only wooden parts are the mahogany base-board (67 × 26 cm.) and the objective-board O. The larger metal parts are of rolled aluminium, and the brass parts are nickelled. The camera C, internally lined with

* Zeitschr. f. wiss. Mikr., xv. (1898) pp. 7–23 (5 figs.).

asbestos, is erected on four solid brass pillars. The sliding door T, with smoked glass window, is only opened to light up the gas flame and to centre the light point with a micrometer-screw. But the camera is then kept closed, because complete regulation is effected outside of and at the back of the camera. B is the projecting part of the burner; M, a manometer for controlling the compressed oxygen; R, the fine adjustment for the gases introduced through the tubes S; P, a levelling screw; L, an aluminium arm leading into the camera, clamped by the screw *l*, and intended to regulate the rear lens of the three-lensed condenser. In front of the camera, fastened by a strong aluminium bar, is the condenser-carrier A, receiving both the front lenses of the condenser, which are therefore placed quite outside the camera, and get scarcely heated at all. They extend with their mounting to a circular opening in the front wall of the camera, and thus leave between themselves and this wall an air-space of 1 cm. clear, through which an extremely effective

Fig. 11.



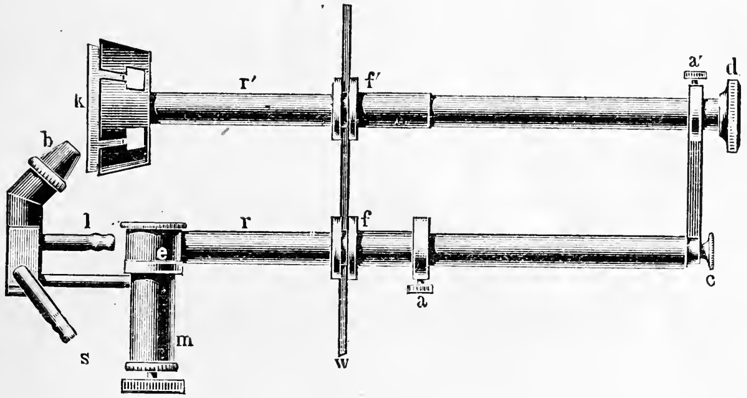
air ventilation is brought into the inner camera. Immediately in front of the condenser stands the diapositive-holder D, in which, by means of the clip *g* the carrier for the glass diapositives can be slipped in and out. D is shut off in front by a smaller aluminium plate, on which the leather bellows E is fastened, whose front aluminium frame slides on two metal runners of the objective-board O. On O, which can be moved backwards and forwards by means of a milled screw-head H, is a lateral micrometer screw *c*, which serves for centering the flame image.

The diapositive-carrier D is movable on two prismatic bars F in two directions by clamp-screws *s*, which bars move in the strong aluminium rail of the condenser-plate A. By relaxing *s*, the diapositive-carrier, the bellows, and objective-board can be removed; the front condenser lens is then completely free, and the apparatus can now be used for the projection of microscopic preparations (fig. 11). But if such objects as culture-tubes and plates, chemical reactions, &c., require to be projected, the objective-board and objective (without the bellows) are re-inserted, and these objects find ample room between A and O.

The *burner* is obviously an essential part of the instrument. The projected image only attains the maximum of sharpness and brightness when the light-source is formed by the condenser exactly in the centre of the rear primary plane of the projecting objective.

Fig. 12 shows the burner, which is intended to secure the following advantages:—(1) The large lime-plate is plane, and stands perpendicularly to the optical axis of the apparatus; (2) the whole burner arrangement is movable parallel to the optical axis; (3) the nozzle-opening is adjustable in every direction to the optical axis, especially perpendicularly, by means of a micrometer-screw. The supporter of the burner is the massive camera back-plate *w*, in which the brass nuts *f f′* are inserted, carrying the brass tubes *r r′*, movable on the release of the clamp-screw *a*. Both are connected by the cross-bar *a′ c*, which can be fixed on *r′* by the clamp-screw *a′* and on *r* by the screw *c*. By the screw-head *d* the lime-plate K in its holder can be rotated in order to

Fig. 12.



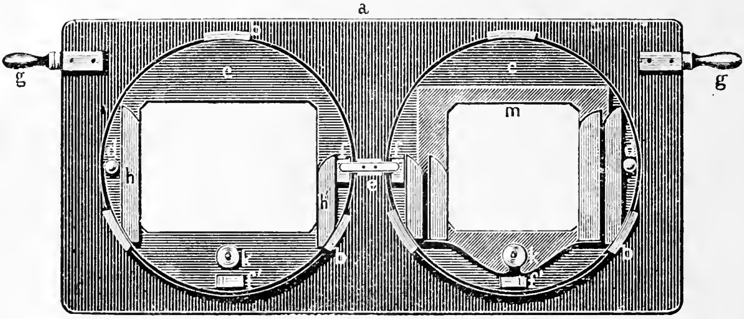
bring new portions of the lime into incandescence. To the tube *r* a copper ring *e* is screwed on, in which the micrometer-box *m* and at the same time the burner-nozzle *b* can be moved sectorwise; a similar movement, but perpendicular to the first, is imparted by *c*; and a micrometer-screw *m* allows a third very fine movement. It is therefore possible to bring the centre of the flame exactly in the optical axis, and by the pushing of *r r′* to bring it into the rear primary plane of the objective.

The *condenser* consists of a concavo-convex back-lens, of 13 cm. diameter, and two plano-convex front lenses of 16 cm. diameter. By means of the concavo-convex lens it was possible to give to the condenser a high numerical aperture, and consequently attain a great light intensity. By the use of an objective system of 25 cm. focus and 20-fold magnification, the N.A. amounts to 0·65. The condenser is also so calculated that the catadioptric secondary images are distributed evenly over the field, and completely uniform illumination is secured.

The *diapositive-carrier* is believed by the author to be of novel design.

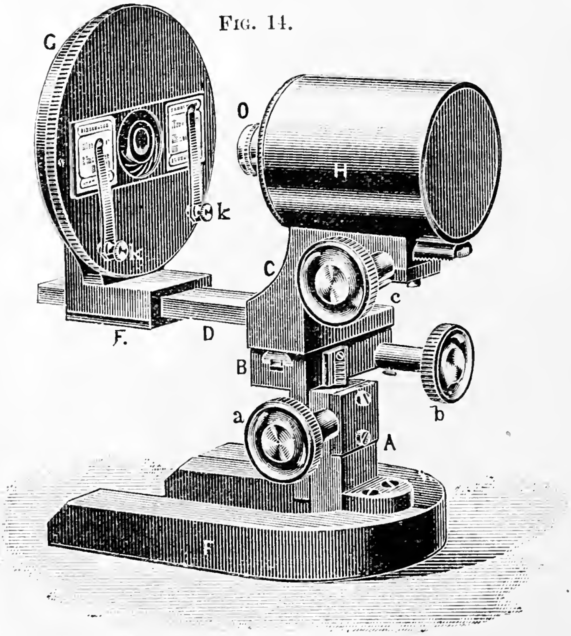
It consists of a lacquered aluminium plate (fig. 13), with two circular perforations of 13 cm. diameter. Two aluminium discs rotate in the

Fig. 13.



brass grooves *b b* by pressing the knob *d*. These discs are perforated rectangularly, and *h h'* are tires for the slides. The left-hand one can receive an upright or a lateral slide. To adapt it for the former the

Fig. 14.

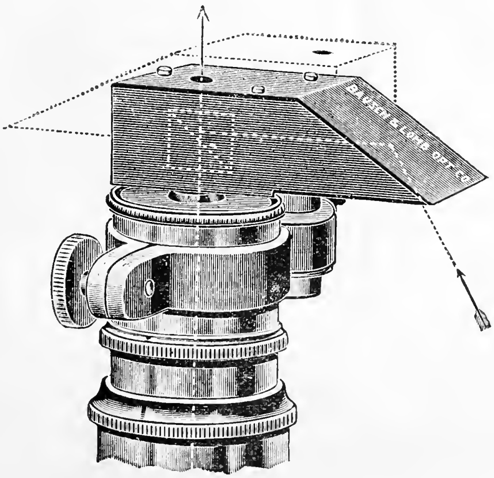


knob *d* is pushed down, thus releasing the catch *f*, and the disc rotates until *f'* catches in *e*. If smaller diapositives are to be used, a suitably sized frame *m* is slipped into *h h'*, as shown in the right of the figure.

The *objective-board* and *objective*, including the optical conditions for perfect projection, are described in detail, and are followed by a discussion of the ordinary method of projecting microscopic preparations by means of their photographs. But in fig. 14 the author explains how he projects from the microscopic preparation itself. The massive horseshoe foot F is fastened on the objective-board by means of a groove and screw R (fig. 11), and can be moved forwards and backwards by the milled head H (fig. 10). On F (fig. 14) the short rectangular pillar A is firmly screwed, in which the cross-piece B is moved perpendicularly up and down by rack and pinion, operated by the screw *a*. The milled head *b* imparts a horizontal movement to the tube-holder. The short tube H has a clear diameter of 48 mm.; it bears a projection Microscope objective at O, and can be focussed on the micro-preparation by means of the milled head *c*. When D is fully extended, an objective of 12 cm. focus can be used. The object stage can be rotated, and has an iris of 25 mm. diameter. The stage, including E, is completely removable; special holders for other objects, e.g. for bacteria cultures, can then be inserted.

Abbe Camera Lucida.—Messrs. Bausch and Lomb bring out a simplified form of this accessory, in which, while the Abbe prism is used as in the large Abbe camera lucida, the mirror is reduced in size and is fixed. The prism and mirror are contained in a neat mounting which is attachable to the Microscope-tube by a clamping ring, and may be

Fig. 15.



swung back out of the way of the eye-piece as shown in fig. 15. A beautifully clear image of the object and of the pencil point is said to be obtained. One feature of this camera lucida is that by means of the clamping ring the distance of the prism from the eye-lens can be varied, and thus the camera used with various oculars.

Monochromatic Light.* — Dr. Wilibald A. Nagel indicates the various difficulties concerned in the employment of prisms for the obtaining of monochromatic light, and recommends instead the use of "*Strahlen-filtern.*" Of these he thinks fluids have many advantages over coloured glass or gelatin films. He gives a complete list for all parts of the spectrum of fluids which can be used for this purpose.

(4) Photomicrography.

Neuhass' Lehrbuch der Mikrophotographie.† — Dr. Neuhass has brought out a second edition of this book, in which he tries to bring the subject up to date. The work is divided into eight sections, viz. (1) The microphotographic apparatus. (2) Objectives and oculars. (3) The light source. (4) The illumination. (5) Arrangements for special purposes. (6) The negative image. (7) The positive image. (8) Preparations; significance of microphotography; microphotograms. This last subsection comprises a review of the chief microphotograms taken during the last ten years by operators of various nationalities. Several of the sections contain a historical subsection.

(6) Miscellaneous.

Theory of the Microscope.‡—Herr Karl Strehl grounds his paper on this subject upon the formulæ obtained by him in his 'Theory of the Telescope,' in conjunction with the proposition (Abbe, Dippel, Czapski, Strehl) that the Microscope = lens + telescope.

As a preliminary he refers to the papers of Lord Rayleigh § and Lewis Wright.‖ He criticises Wright's view that "for irregular and unperiodic detail wide-cone illumination is the most useful, because it brings the object into a condition approximating to theoretical self-luminosity." He only admits this statement when an image of a self-luminous surface can be formed in the object-plane by means of an apochromatic condenser, whose N.A. is as much as possible greater than that of the apochromatic observation system. For the limit of fineness of resolvable detail is accidentally determined for self-luminous objects in the same way as for those objects which are illuminated with extremely oblique plane waves, and indeed depends only on the wave-length and the numerical aperture. For self-luminous objects he finds the limit given by $\zeta = (2 \cdot 95 : 2\pi) . (\lambda : n \sin a)$, and for extremely oblique light Abbe's theory gives $\zeta = \lambda : 2 n \sin a$; both values are equal up to 6 degrees. Strehl's previous value of $\zeta = (3 \cdot 20 : 2\pi) . (\lambda : n \sin a)$ gives an experience limit of 3 to 4 degrees for the observer's eye. He admits that with this mode of illumination images may be less distinct, but that they are more truthful. He has found wide light-cones give a notable resolution of the finest details of butterfly scales, and agrees that *not only* in the case of coloured isolated structure-elements is such illumination advantageous. He points out that his statement, "the influence of spherical aberration has been considerably over-rated in objectives," was misunderstood by Wright, as he was only referring to telescope objectives.

* Biol. Centralbl., xviii. (1898) pp. 649–55 (with spectral maps).
† Bruhn, Braunschweig, 1898, 266 pp., 62 woodcuts, 2 autotypes, and 2 pls.
‡ Zeitschr. f. Instrumentenk, 1898, pp. 301–17. § Phil. Mag., xlii. (1896) p. 167.
‖ Op. cit., xlv. (1898) p. 480. Cf. this Journal, 1896, p. 681; 1898, p. 592.

On the Abbe theory the hinder part of the ray-path can be regarded as coming from a telescope objective, which, however, does not work with full aperture, but is rather covered up except for a row of little windows corresponding to the diffraction spectra. To these little windows must be ascribed an elementary surface. The achromatic undiffracted centre is a primary maximum, and the lateral chromatic images the discontinuous diffraction appearances. Therefore, to produce monochromatic microscopic images no Microscope is necessary; a telescope may be directed towards a point monochromatically illuminated, and the objective covered up except a large slit (primary maximum) and several small slits (secondary maxima). Such an arrangement works as a Microscope as soon as the totality of the wave-lengths is taken into consideration; for in this case the secondary maxima have constant distances from the primary maximum, which distances in the Microscope are proportional to the wave-lengths. His treatment is an enlargement upon Eichhorn's 'Bestimmung der Interferenzen von mehreren Isochronen und in gleicher Phase schwingenden Lichtzentren,'* both in depth and in scope: in *depth*, because Eichhorn treated the diffraction spectra as lying in *one* plane instead of on a spherical surface; in *scope*, because Strehl treats of the environment in space of the wave-centre, and includes spherical aberration, coma, cylindrical waves, distinction between direct and oblique light, and chromatic aberration. Moreover, he pays due heed to the laws of conservation of energy neglected by Eichhorn.

In discussing each subject he quotes the corresponding equations from his 'Theorie des Fernrohrs,' and deduces the following propositions.

Aplanatic image-formation.—(1) If a definite group of diffraction spectra be displaced on the spherical wave-surface, the inner and outer proportions of the microscopical image thereby formed are left unchanged.

(2) The microscopical image is achromatic in the focal plane, chromatic in the image plane and along the optic axis.

(3) The fineness of delineation in the microscopical image is, both in the focal plane and in the corresponding image-planes and along the optic axis, proportional to the wave-length of the light source.

(4) The fineness of delineation in the microscopical image is, in the focal plane and the corresponding image planes, inversely proportional to the linear extent of the group of diffraction spectra.

Chromatic aberration.—(5) The excellence of the microscopical image is attained by means of an integration over the various wave-lengths.

Direct illumination.—(6) If a primary maximum lies in the midst of a circle of secondary maxima, then is the microscopical image along the optic axis a regular simple periodic function of the spot—monochromatic light being assumed.

(7) If a primary maximum lies in the middle of a circle of secondary maxima taken by pairs of opposites, then complete images alternate with images of exactly opposite character along the optic axis at constant distances—monochromatic light being assumed.

(8) If a primary maximum lies in the midst of a regular polygon of secondary maxima, then the pattern of the microscopical image in the

* Jena, 1878.

image-planes is completely contained within the corresponding radial angle.

(9) If a primary maximum lies in the midst of a circle of secondary maxima taken by pairs of opposites, and linear periodic relations between x and y are possible for which the expression $\int \cos(x \cos w + y \sin w)$ takes a constant value, then the microscopical image in the image-planes assumes parallel bands of constant intensity at constant distance—in those directions to which the secondary maxima lie symmetrically when taken by pairs.

Strehl then discusses the special cases of *Synedra pulchella*, *Pleurosigma attenuatum*, and *P. angulatum*.

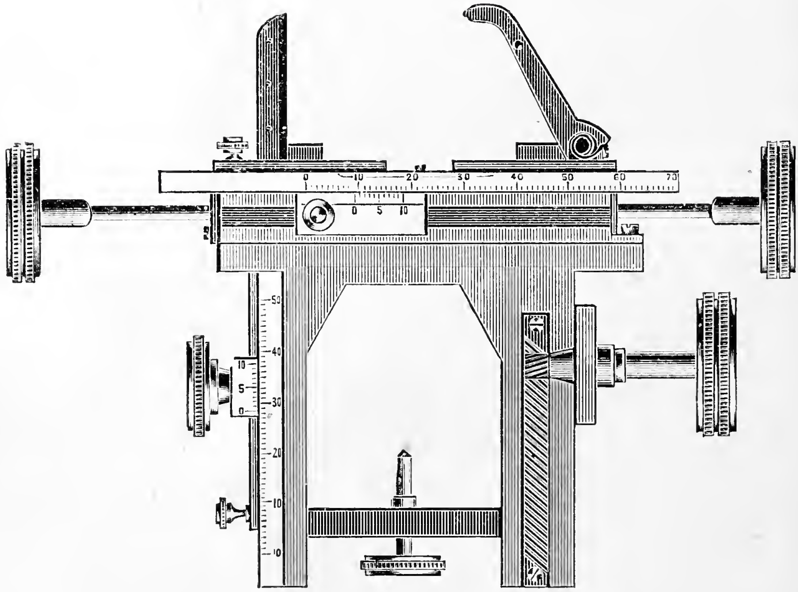
(10) *Oblique illumination.*—Here he assumes that the group of spectra consists of a polygonal arrangement of one primary and several secondary maxima.

(11) If the primary maximum forms a circle with the secondary maxima, then the microscopical image along the optic axis is independent of the spot.

The special cases of the same three diatoms are severally considered.

The subjects of astigmatism, cylindrical waves, spherical aberration, zonal refraction, and coma, are then similarly considered, but the results do not lend themselves to the enunciation of propositions.

Fig. 16.



New Stage Finder.*—Messrs. Koltzoff and Ivanoff propose a new form, which has been made for them by Reichert, of this accessory.

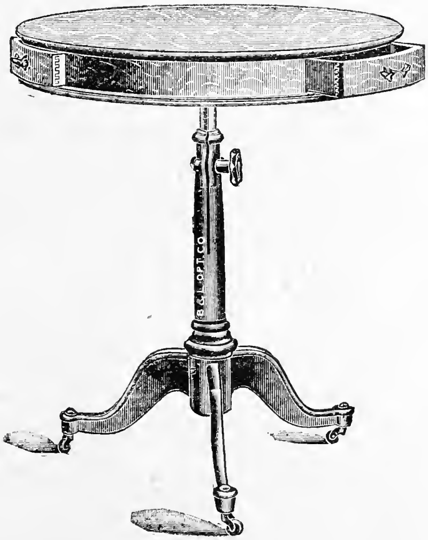
* Zeitschr. f. wiss. Mikr., xv. (1898) pp. 3–7 (1 fig.).

Most finders labour under two disadvantages, viz. (1) inadjustability to different Microscopes for comparison purposes, owing to variations in stand and objective construction; (2) unreliability, even on the same Microscope, owing to the difficulty of securing a precisely similar adjustment. The authors' object is to obtain an absolute means of recording the position of any part of a preparation, and one which shall moreover be independent of any particular make of Microscope.

They propose to indicate such a position by means of co-ordinates measured parallel to the top and left-hand edges of the slide, and every adjustable stage lends itself to such measurements. The readings of the scales should be so altered that the indicator is at zero when the left edge of the slide is in the centre of the field of view. If any instrument does not happen to give zero under these circumstances, the reading should be carefully noted once for all and subtracted from the actual reading of any required point in the preparation. This will give one co-ordinate, and the other can be ascertained similarly. A simplification would be introduced if the scales were made movable for adjustment in the direction of their long axis. The figure (fig. 16) will make the authors' arrangements clear.

Microscopist's Table.—This piece of furniture (fig. 17), designed by Messrs. Bausch and Lomb, has a revolving top and vertical adjustments. It is made of solid quartered oak with japanned iron base. The top is

Fig. 17.



76 cm. in diameter, and has three drawers with brass handles. The table may be raised and lowered as desired from 79 cm. to 112 cm., and clamped in position by a heavy hand clamp, the adjusting bar being 3 cm. in diameter. The table is equally as stable as if supported on four

legs. The revolving top can, when desired, be clamped by a separate hand clamp.

Illustrated Annual of Microscopy.* — Among other interesting articles in this Annual may be mentioned especially :—

'Achromatics and Apochromatics,' by E. J. Spitta. A very interesting popular account of these lenses.

'Elementary Theory of the Microscope.' An excellent treatise by Mr. Conrad Beck ; contains a treatment of microscopical optics on the methods of Gauss.

B. Technique.†

(1) Collecting Objects, including Culture Processes.

Apparatus for Anaerobic Cultivation.‡—Herr L. Źupnik has devised an apparatus by which a perfect vacuum is secured. The main part of the apparatus is a cylindrical glass vessel K (fig. 18) having narrow tubes at both ends which can be closed by stop-cocks H_1 and H_2. The culture vessel is completely filled with a nutrient solution, and after inoculation the tap H_1 is closed. To the lower end is now fitted on, through the intermediary of a rubber joint *Sch*, a thick glass tube R 80–90 cm. long. The apparatus is now reversed, and the tube R completely filled with mercury. The end of the tube having been closed with the finger, and the apparatus restored to its former position, it is now plunged into a vessel W filled with mercury.

On removing the finger the mercury sinks, and a Torricellian vacuum is produced. The tap H_2 is now opened, the medium flows down, leaving an airless space above. After closing H_2 the tube R is removed and the apparatus placed in the incubator. According to the length and width of the tube R, any desired quantity of medium can be removed. In this way quite a large space may be left above the level of the culture medium. This serves for the collection of any gas required for chemical examination.

Apparatus for Cultivating Anaerobic Bacteria.§—Dr. S. Epstein describes an apparatus which he has used with success for a considerable period. As shown in the illustration (fig. 19), it consists of an Erlenmayer's flask A closed by a perforated rubber plug B. Into the perforation is inserted a glass tube expanded above at G and provided with a Bunsen's air-valve L. On the expanded portion of G rests a bell-jar T. The flask is filled with the medium, and the latter inoculated. The rubber plug is then pushed home. This causes the medium to rise in the tube as far as the valve. The air-valve L is made out of a piece of caoutchouc tubing by snipping it at V with scissors and thus forming an angular (<) valve. The bell-jar is filled with a 2 per cent. boric acid solution, so that the valve lies below the level of the fluid. The gases from the

* London, P. Lund Humphries & Co., Limited, 1898.

† 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, &c.; (6) Miscellaneous.

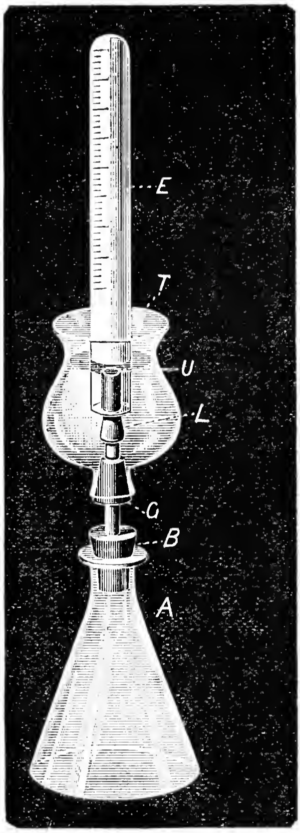
‡ Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 267–70 (1 fig.).

§ Tom. cit., pp. 266–7 (1 fig.).

culture escape unhindered, but if necessary may be collected by inverting over the valve a endiometer E filled with the boric acid solution.

Fig. 18.

Fig. 19.



Pure Cultures of Amœbæ.*—M. J. Tsujitani has been able to obtain pure cultures of amœbæ on substrata containing bacterial products and dead bacteria. Three varieties of *Amœba lobosa* were used, and were cultivated in company with bacteria in the usual manner. The most convenient bacterium was the cholera bacillus. From these mixed cultures amœba cysts were obtained by dipping silk threads therein and

* Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 666–70.

then drying the threads in a sulphuric acid exsiccator. This killed off the cholera bacilli, leaving only living amœbæ in the cyst form. These cysts, when inoculated on gelatin or agar substrata, developed, but did not multiply. But by inoculating the cysts on a medium in which bacteria had been bred, they grew and multiplied, although they did not, as a rule, thrive quite so well as when living bacteria were present. With a bacillus isolated from hay, however, the results were practically as good as when the cultures contained living bacteria. The medium used was composed of 1–1·5 grm. agar, 20 grm. bouillon, and 80 grm. water; its reaction was alkaline. The medium was heated to 60°–70° to kill off the bacteria, and then used for the amœba cultures.

Cultivating Pleurococcus vulgaris.*—Herr M. W. Beijerinck cultivates *Pleurococcus vulgaris* in the following medium. Agar is soaked in distilled water until all the soluble organic bodies are dissolved out, and 2 per cent. thereof is added to the following mixture:—distilled water, 100 parts; ammonium nitrate, 0·05; potassium phosphate, 0·02; magnesium sulphate, 0·02; calcium chloride, 0·01. Over plates composed of the foregoing mixture is poured some of the material rubbed up in water. The material is derived from the green deposit on trees, roofs, walls, and hedges. The superfluous water having been poured off, the plate, carefully protected from dust, is placed in a window with a southern aspect. The green colonies show up in about three weeks. The author's first successful cultures were made in the winter of 1896, since which he has kept perfectly pure cultures, and these have remained constant and monomorphic.

(2) Preparing Objects.

Application of Engelmann's Method to the Examination of Animal Tissues.†—As long ago as 1881, Engelmann adopted a method which was capable of demonstrating the presence of very small quantities of oxygen. The reagents were putrefaction-bacteria, and the material green alga cells. A drop of the water was placed on a slide, a few alga cells were added, and then a cover-glass was put on. In a short time crowds of lively bacteria were found close about the alga cells. The addition of blood, muscle, &c., showed that the liveliness of the movements and the massing of the bacteria were dependent in the first place on the quantity of oxygen disposable for respiration, and in the second place, when this is copiously present, on the nature of the added nutrient material. Herr A. Exner has applied Engelmann's method to the examination of blood, voluntary muscle, heart muscle, fat, liver, thyroid, frog's ovary, spleen, cartilage, brain and spinal cord, nerve and retina, all of which gave a positive reaction; while bone, lung, skin, gastric mucosa, kidney, sub-maxillary gland of cat, pancreas and ovary of rabbit, were negative. The bacteria used were *Bac. fluorescens liquefaciens* and *B. aquatilis communis*.

Impromptu Method of making a simple Freezing Apparatus.‡—Mr. H. E. Durham gives the following prescription for extemporising a refrigerator for bacteriological purposes.

* Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 785–7.
† Sitzber. k. Akad. Wiss. Wien, cvi. (1897) pp. 58–65.
‡ Brit. Med. Journ., 1898, ii. p. 1801.

Take a moderately large tin, such as a biscuit tin, and a wooden box of sufficient size to give 3 or 4 inches clear space in every direction when the tin is placed within it. Put a layer of sawdust 3 or 4 inches deep at the bottom; stand the tin upon this, and fill the surrounding space with sawdust also. The various organs, after being removed with as much cleanliness as possible, are each wrapped in a clean cloth wetted (not wringing wet) with 1–500 $HgCl_2$, and further wrapped and sealed each separately in a piece of gutta-percha tissue (most easily done with a trace of chloroform); they are then put into one or more watertight tins (those 1/4 or 1/2 lb. tins in which some tobacco is sent out are admirable; they may be more securely closed by means of a paraffin candle and a warm poker). The tobacco tins are placed within the larger tin, together with pounded ice and common salt, in the proportion of 3 lbs. of ice to 1 lb. of salt. The lid is placed on the larger tin, and the wooden outer box filled up with sawdust. An apparatus which holds the above quantities of ice and salt will keep about 1/2 pint hard frozen for more than twenty-four hours. There can be no difficulty in obtaining these materials at a moment's notice. The maintenance of objects at a low temperature when bacteriological examination cannot be carried out completely on the spot, is essential for satisfactory results to accrue.

Demonstrating the Coccidia of Cuttle-fish.*—The specimens used by M. M. Siedlecki were obtained from the Gulf of Naples, and all the animals examined were found to be more or less infected. The parasites, localised in the digestive apparatus, are recognisable by the naked eye as white opaque spots in the posterior part of the intestine. Observations were made on fresh and also on fixed and stained specimens.

Fresh specimens were placed on cover-glasses the corners of which had been slightly melted in the flame of a Bunsen's burner. In this way the cover was supported on four footlets, and crushing of the preparations avoided. The specimen was immersed in sea-water or in intestinal juice, was broken up as little as possible, and then placed on a slide for examination.

Stained preparations were made from teased-out pieces and from sections, the former giving the best results. A piece of intestinal mucosa and submucosa, from 5 to 10 mm. square, was placed on a cover-glass, teased out in sea-water or in intestinal juice, and carefully spread over the whole surface of the cover. The cover was then placed film side down on the surface of the fixative solution. In this way the layer is at once fixed, and also caused to adhere to the cover. If the fluid (sea-water or juice) be in excess, the adhesion of the film will be imperfect, and some of the preparation will drop off; while if the film be allowed to dry before being fixed, the structure of the Coccidia is profoundly altered or destroyed.

The best fixative is a saturated solution of sublimate in sea-water to every 100 ccm. of which 3 to 5 drops of glacial acetic acid have been added; Flemming's and Hermann's fluids also gave good results. After fixation the films are washed in water, next in alcohols of increasing strength (30°, 50°, 70°, 96°, 100°), and then the preparations are ready for staining. The time required for immersion in the fixative is from

* Ann. Inst. Pasteur, xii. (1898) pp. 801–3 (3 pls.).

30 minutes to 1 hour; in the alcohols, 10 to 30 minutes, except in the absolute, which is 30 minutes to 1 hour. After the absolute alcohol the preparations are returned to 50° spirit.

For staining, Böhmer's hæmatoxylin was used. The preparations were immersed in a very dilute solution for 12–24 hours, and afterwards differentiated in 50° spirit faintly acidulated with hydrochloric acid. This treatment turns the colour red, but the blue hue is restored by washing in faintly ammoniacal 50° spirit.

For certain details Heidenhain's iron-alum hæmatoxylin is useful. The preparation may be contrast stained with eosin or with eosin and orange G. The preparations should remain in very weak solutions for 3–12 hours. For pieces which have been treated with Flemming's fluid, safranin is recommended.

Lactic Acid in Botanical Microtechnique.* —Though lactic acid was introduced into botanical microtechnique quite ten years ago, says Herr F. Krasser, it has been but little employed. In the hot condition it was used as a solvent, in the cold as a fixative. With glycerin lactic acid has certain properties in common; it is of syrupy consistence, it is as clear as water, it is miscible with water and alcohol, it forms soluble salts, and has the property of extracting water. On the other hand, while it is miscible with ether, glycerin is not. It penetrates vegetable tissues more quickly than glycerin. Both are clarifying, and in both chloral hydrate can be dissolved for raising the refractive indices. At ordinary temperatures lactic acid causes but little swelling of vegetable membranes and starch-granules; hence it is more suitable than glycerin and lactophenol for observing and preparing starch-granules and amylaceous tissue. Next to starch it is of service for examining different kinds of flour. A small mass of flour may be mixed with acid and examined directly, or the mass may be placed between cover-glass and slide and the acid allowed to run in. Tissues which contain aleuron-grains as well as starch can be equally well examined and preserved in lactic acid. For tissues containing fat and a pigment it does not appear to be suitable.

The chief value of lactic acid in microtechnique is as an observing reagent and preservative medium for starch, amylaceous tissue, and flour.

Cover-glass Preparations of Amœbæ.†—In order to obtain good preparations of amœba, M. J. Tsujitani uses the following method. A droplet of distilled water is placed on a cover-glass, then a small quantity of an amœba culture, and lastly a loopful of a saturated solution of hydrochlorate of quinine. After they have been mixed and spread out, the layer is allowed to dry in the air, and is then fixed in the alcohol-ether mixture. The preparation is stained with methylen-blue.

Decolorising Algæ.‡ — Dr. H. C. Sorby has found that diluted formalin has a powerful action on the colouring matter of algæ, and has succeeded in so reducing the colour of some very dark spines as to be

* Zeitschr. d. allgem. österreich. Apotheker-Vereins, lii. (1898) No. 21. See Bot. Centralbl., lxxvii. (1898) pp. 89-90.

† Centralbl. Bakt. u. Par., 1[te] Abt., xxiv. (1898) p. 670.

‡ 'Floreamus' (Sheffield), 1898, No. 4, p. 68.

able to prepare lantern slides which show the natural beautiful colouring and not mere dark shadows.

Preserving Medulla oblongata of Rabid Animals.* — Dr. E. J. Frantzius has found that for the experimental detection of rabies, it is sufficient to expose the spinal marrow of the suspected animal, and, having removed a piece from the medulla oblongata, to place this in a bottle filled with either glycerin or sterile water. When properly corked and packed in a wooden case, it is ready for transportation. All other precautions are unnecessary. Pieces of the central nervous system of rabid animals treated in this way retain the virus so effectively that animals may be successfully inoculated after several weeks' immersion. The instance of a brain immersed in glycerin remaining virulent on the 152nd day is quoted.

Detection of Blepharoplasts in Onoclea and Marsilia.†—Sections of *Onoclea Struthiopteris* in paraffin prepared a year beforehand, fixed by 1 per cent. chromic acid, and stained with cochineal-alum and Bismarck brown, were washed in xylol, absolute alcohol, and water, placed in 1 per cent. chromic acid for 24 hours, and then stained by Flemming's safranin-gentian-violet-orange preparation. Sections prepared in this way by Mr. W. R. Shaw, displayed an excellent distinction between cytoplasm and nucleus in the antherozoids which had collected in the mucilage before the open archegones. Male and female prothallia of *Marsilia vestita* and *quadrifolia* were treated in the same way with great success.

Killing and Preserving Marine Animals.‡—Dr. H. C. Sorby finds that by adding a small quantity of menthol to the sea-water in which marine animals are kept, they fully expand themselves, and finally die in a distended condition, and can be so preserved permanently in a 4 per cent. solution of formalin. In this manner he has preserved *Synapta* in its natural form and several species of sea-anemones beautifully distended. The author has also more fully developed a method of killing some animals with diluted glycerin, which is afterwards removed by water, and has thus been able to mount sundry worms in Canada balsam, so as to preserve even the minute blood-vessels filled with the natural red blood.

Technique of the Tuberculous Serum Reaction.§—For obtaining homogeneous cultures of tubercle bacilli suitable for demonstrating the agglutination phenomenon, MM. S. Arloing and P. Courmont recommend beef or veal bouillon with 1 per cent. peptone and 6 per cent. glycerin. The cultivation-flasks should be flat-bottomed, and the cultures should be frequently shaken. Cultivations from 8 to 12 days old are the most favourable for the reaction.

For observing the agglutination phenomenon satisfactorily, it is necessary to use blood-serum only. The serum is obtained by means of special tubes, or by centrifuging if there be no clot in the tubes. With each serum three mixtures of different strengths are prepared,

* Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 971–4.
† Ber. Deutsch. Bot. Gesell., xvi. (1898) p. 178.
‡ 'Floreamus' (Sheffield), 1898, No. 4, p. 68.
§ Comptes Rendus, cxxvii. (1898) pp. 312–5, 425–8.

1/5, 1/10, 1/20, i.e. one drop of serum to five of culture, and so on. The tubes are examined after 2, 10, and 24 hours. The effect may be observed with the naked eye or through the Microscope. In the former case there is a deposit, the rest of the fluid being clear. Microscopical examination is used for control.

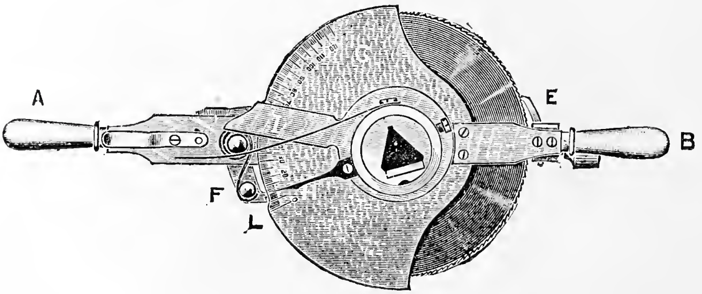
The clinical value of the reaction, as tested on tuberculous and non-tuberculous persons, is reported as follows. Of the tuberculous cases, 95 per cent. gave the reaction. In the non-tuberculous cases, composed of (*a*) persons suffering from diseases other than tuberculosis, and (*b*) of presumably healthy persons, positive results were also obtained. In group (*a*) 33 per cent. were positive, and in group (*b*) over 50 per cent. The inference drawn by the authors from these latter results is that they were evidence of latent tuberculosis.

While admitting the difficulty of the technique, the authors are very confident as to the value, from a clinical point of view, of the tuberculous serum reaction as an aid to the diagnesis cf tuberculosis, espccially in its earlier stages.

(3) Cutting, including Imbedding and Microtomes.

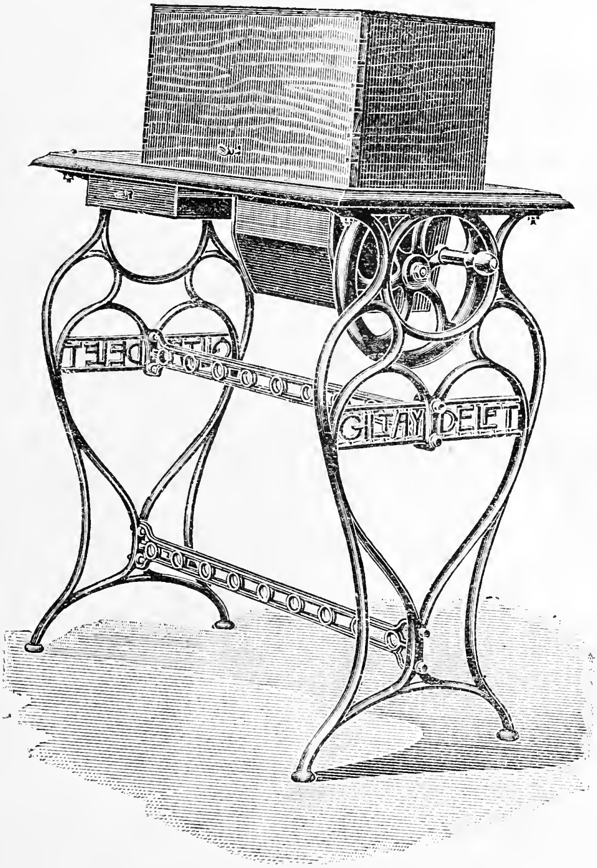
Minot's Automatic Precision Microtome.—The feed arrangement of this machine, as made by Messrs. Bausch and Lomb, is shown in fig. 20. It consists of a micrometer-screw, having pitch of 0·5 mm., which elevates the object-holder. The motion of the screw is transmitted to the object-holder through a triangular bar moving smoothly but firmly in a triangular channel, all lateral motion being eliminated by means of a wedge. The micrometer screw is provided at its lower extremity with two metal discs in contact, each having one hundred serrations, the acute angles of the upper disc pointing to the right, and

Fig. 20.



those of the lower to the left. The discs are revolved by means of the lever A, which is pivoted loosely on the axis of the micrometer-screw and provided with a pawl F. F is actuated by the small lever shown on the upper surface of A, so that when the actuating lever is thrown to the left, F engages the teeth of the upper disc, and motion of A to the right elevates the object. The spring ratchet E prevents any backward motion of the screw-head, and may be disengaged by means of the thumb-screw shown. After the screw has been fed up to its greatest extent, it is quickly returned by bringing the actuating lever to the right, when a small pawl (not shown in figure because beneath the lever) engages the teeth of the lower disc, and motion of A to the left depresses the object-carrier. The amount of elevation of the object is controlled in an entirely automatic manner. The stop I is a rigid attachment, and is provided with an index H. C is a graduated disc,

Fig. 21.

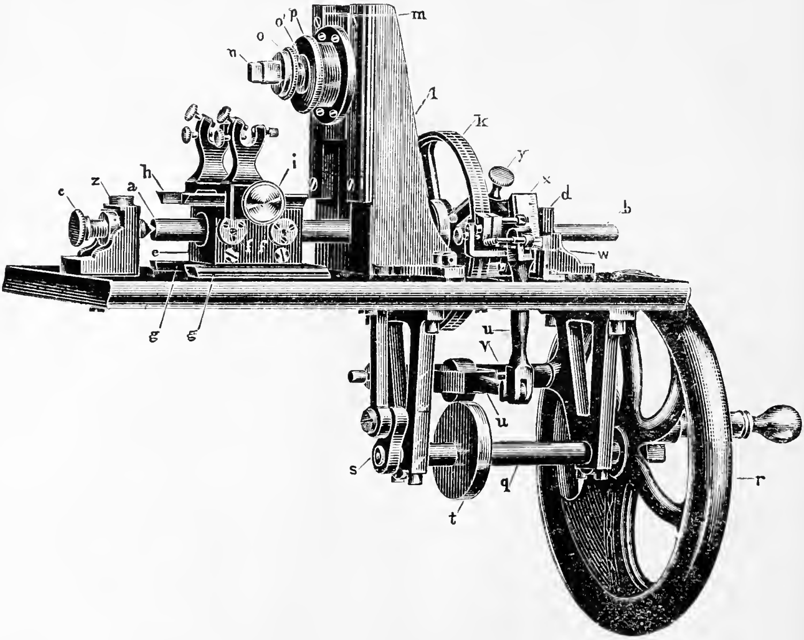


pivoted around the axis of the feed, and movable by means of the lever B. Two of the graduations on C correspond to one of the notches on the disc of the micrometer-screw.

Beginning at zero of the scale, the circumference of C has an inclined plane for the following purpose; the disc C being set so that the number indicating the desired thickness of section is opposite the index, the stop-post of A is held against the stationary stop I by the long spiral spring; F engages a tooth of the upper disc. If now the lever A is moved to the right, F will continue to engage the tooth of the disc until the guide-post L comes in contact with the inclined plane on the margin of C, when the pawl F will be disengaged from the tooth of the disc exactly at the zero point of the scale. It will thus be seen that, no matter how far A may be moved, F will act only through a certain definite distance, governed by the position of the inclined plane of C, and that the amount of elevation of the object at each cut is definitely indicated by the position of the pointer H on the scale.

Some Improvements in the Reinhold-Giltay Microtome.*—A description of this instrument has already appeared in the Society's Journal,† and Dr. J. W. Moll now describes some improvements.

Fig. 22.



(1) The wooden *table* bearing the instrument is now replaced by one of cast iron, designed by Messrs. Gips, instructors at the Delft Polytechnic (fig. 21).

(2) *The reading-off apparatus.*—Fig. 22 shows the old form of the instrument, and will facilitate comprehension of the changes. By loosening the screw, the segment *x* can be adjusted so that at each stroke of the wheel K, 1 to 40 teeth can be rotated. The number of mikrons corresponding to the teeth is given by the indicator on the segment. The divisions of the segment are marked on its upper nickelled surface, and

* Zeitschr. f. wiss. Mikr., xv. (1898) pp. 23-9 (4 figs.).

† Cf. this Journal, 1893, pp. 706-11.

are therefore somewhat hard to see. Moreover the segment is too small, and the division lines therefore too close; and one has to bring one's head almost to the horizontal plane of the table. These inconveniences are remedied by the application of a different and larger segment. The

FIG. 23.

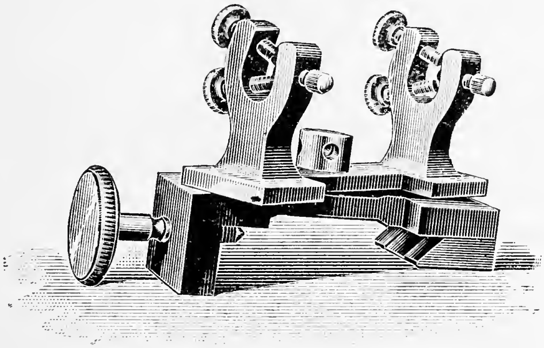
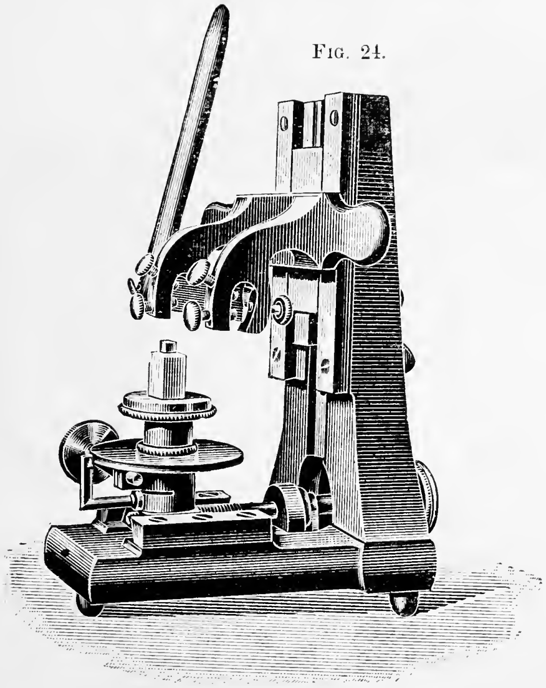


FIG. 24.



divided surface of the new segment is placed vertically, and is $1\frac{1}{2}$ times greater than before. Instead of on a shining metallic surface, the division lines are now marked in black on a white celluloid strip.

(3) *A knife-carrier rotatory about a vertical axis.*—The original in-

strument allowed only a backward and forward movement. The nature of the improvement is shown in fig. 23.

(4) *A shaping apparatus.*—It is very convenient to possess an apparatus capable of cutting the paraffin blocks into true rectangular forms; at the very least the opposite faces should be accurately parallel to the knife-blade. Fig. 24 shows this piece of auxiliary apparatus. The knife-holder slides in the swallow-tailed grooves of the vertical part of the cast-iron stand. Behind the runners of the knife-carrier is a vertical column space, which makes it possible to fix a square plug by means of a winged nut just visible on the right of the figure. As the knife-slide in sinking strikes on this plug, the extent of its fall can be accordingly regulated.

The horizontal slide for the paraffin block moves in swallow-tailed grooves, and is regulated by a milled head as shown. The cylindrical metal piece on which the paraffin saucer is fastened is a broad rotatory clamp-ring divided into quadrants; and this clamp-disc is rotatory on a second clamp-disc firmly secured to the slide; the adjacent milled head fastens both discs together, whereby the paraffin saucer is made fast. When one side of the paraffin block has been shaped, the quadrant disc is released, rotated 90°, and again fixed; thus a second side is shaped, and so on. For shaping the block an ordinary razor is used, but too broad a one should not be chosen, as a feather-edged blade breaks the block. It is best to incline the knife about 5° to the vertical. For this purpose a copper right-angled triangular plate is added to control the fixing of the knife.

(4) Staining and Injecting.

Staining the Capsules of Pneumococcus and of the Bacillus of Friedlaender.*—Mr. A. MacConkey recommends the following solution for staining bacterial capsules; the combination gives a clear image which photographs well. Dahlia 0·5 grm.; methyl-green (00 crystal) 1·5 grm.; saturated alcoholic solution of fuchsin 10 ccm.; distilled water to 200 ccm. The dahlia and methyl-green are rubbed up in a mortar with part of the water until dissolved, then the fuchsin is added, and finally the rest of the water.

Staining.—Prepare the film in the usual way. Flood the cover-slip with the stain, and hold over the flame until steam begins to arise. Then place aside for about five minutes, wash in water, dry, and mount in balsam. If the film be treated with acetic acid before staining, the result is not so good.

The solution is also a good general stain, especially for the Klebs-Loeffler bacillus and for *Bac. typhosus* and *Bac. coli communis.*

Permanent Stain for Starch.†—A very good and durable stain for starch may be obtained, says Mr. J. H. Schaffner, by the use of anilin-safranin and gentian-violet. (1) Anilin-safranin solution is prepared by mixing equal parts of anilin water and saturated alcoholic solution of safranin. (2) Two per cent. aqueous solution of gentian-violet.

Stain for 2–4 hours in the safranin, and from 2–8 minutes in the gentian-violet. The slides should be taken through the alcohols quickly. The stain is a purplish-red, and the cells look filled with the coloured starch-grains.

* Lancet, 1898, ii. p. 1262. † Journ. Applied Microscopy, i. (1898) p. 181.

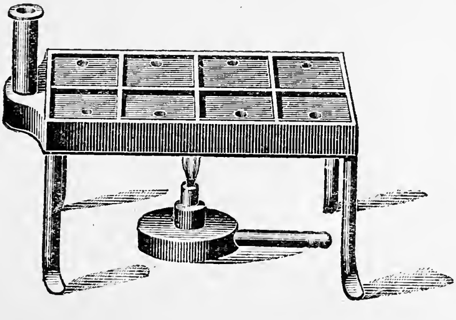
New Test for Cellulose.*—The ordinary reagents for cellulose may be divided into three groups:—(1) Iodine reagents. (2) Pigments such as orsellin B B, which stain in acid solution. (3) Pigments such as Congo, benzo-purpurin, brilliant-azurin, which require an alkaline reaction.

Instead of these, Sig. A. Cutolo recommends hydriodic acid of 0·45–0·60 Bé. to be used in the following way. The specimen to be examined, moistened with water or alcohol, is to be placed on a slide, and the excess of fluid removed by filter-paper. A few drops of the acid are then added and afterwards washed off. The preparation may now be examined; but if permanent staining be desired, it is advisable to add beforehand a few drops of iodised calcium chloride solution. If the latter be strong, the membranes assume a violet hue; if weak, a blue.

Staining Gonococcus.†—Dr. M. Weinrich advises staining *Gonococcus* by the following method, which is really Gram plus Bismarck brown. The fixed dried preparation is treated with Ehrlich's anilin-gentian-violet solution, or with Fraenkel's phenol-gentian-violet solution, for 1–3 minutes. It is then immersed in Lugol's iodo-potassic iodide solution for 1–3 minutes, after which it is decolorised in perfectly absolute alcohol. The alcohol must contain some crystals of cuprum sulph. exsicc. The last step takes from 1–1½ minutes. So far, no water is used; but when the Gram's staining is finished, the preparation should be washed in water, and contrast stained for 2–3 minutes in the following solution of Bismarck brown:—Hot distilled water 70; Bismarck brown 3·0; 96 per cent. alcohol 30; then filter. The *Gonococci* are stained brown and other bacteria violet.

Hot Staining Bath.‡—Herr Piorkowski has devised an apparatus for staining preparations with hot solutions. It consists of a quad-

Fig. 25.



rangular water-bath, the top of which is divided into square compartments for the reception of the staining fluids (see fig. 25).

A number of preparations may be treated at the same time. The chimney serves both for filling the bath and for the escape of the steam.

* 'L'Orosi,' 1897, p. 303. See Zeitschr. f. angew. Mikr., iv. (1898) p. 205.
† Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 258–65.
‡ Deutsch. med. Wochenschr., 1898, No. 20. See Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 902–3 (1 fig.).

The apparatus will be found extremely useful for staining tubercle bacilli, spores, and flagella.

Staining the Malaria Parasite.* — Dr. Nocht states that neutral polychrome methylen-blue makes an effective addition to the ordinary double stain of eosin and methylen-blue for the malaria parasite. The staining solution is made by mixing 1 ccm. of neutral polychrome methylen-blue with an equal quantity of water, and then dropping in saturated aqueous solution of methylen-blue, until the solution is of a dark-blue colour. In a second capsule are mixed 3–4 drops of a 1 per cent. aqueous solution of eosin, and 1–2 ccm. of water. To the latter the methylen-blue mixture is added drop by drop until the eosin solution has become quite dark blue.

Method for Double Staining Flagellata, Fungi, and Bacteria.†— Dr. H. Ziemann finds that a satisfactory double staining can be effected in 20–40 minutes by using 1 part of 1 per cent. methylen-blue solution (Höchst) mixed with 5 to 6 parts of a 0·1 per cent. eosin solution (eosin A G or B A Höchst). By adding borax to the methylen-blue solution, the staining becomes more effective and rapid. Four different solutions are enumerated. (1) 1 part methylen-blue, 1 part borax, and 100 water; (2) 2 parts borax; (3) 2·5 parts borax; (4) 4 parts borax. The first of these behaves very much in the same way as the solution without borax; but the last three, when mixed with 4 parts of 0·1 per cent. eosin solution, impart a satisfactory staining in 5 minutes. If the preparations become overstained with blue, this can be easily reduced by means of 0·1 eosin solution.

(5) Mounting, including Slides, Preservative Fluids, &c.

Micro-Cements for Fluid Cells.‡—In a note on this subject Mr. C. F. Rousselet, after mentioning the difficulty he has found in permanently sealing micro-cells containing a watery fluid, recommends the closing of cells containing dilute formalin as the preservative fluid; first with a coat of cement made by mixing two-thirds of dammar in benzol and one-third of best gold size; then three or four coats of gold size (pure); and finally a coat of Ward's brown cement. Clark's spirit-proof cement, previously recommended, has failed to prevent the evaporation of watery fluid, while for spirit mounts it as good as ever.

* Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 839-43.
† Tom. cit., pp. 945-55 (1 pl.).
‡ Journ. Quekett Micr. Club, vii. (1898) pp. 93-7.

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on the 21st December, 1898, at 20 Hanover Square, W., The President (E. M. Nelson, Esq.) in the Chair.

The Minutes of the Meeting of 16th November last were read and confirmed, and were signed by the President.

In accordance with notice given at the preceding meeting, the President then declared the meeting to be made special for the purpose of suspending Bye-law No. 36. As explained at the November meeting, the Council had requested him to accept the office for the third year, and the suspension of this bye-law became necessary in order to enable him to do so.

The motion "that Bye-law No. 36 be suspended in accordance with the notice given," was then put from the chair and unanimously carried.

The President having declared the Special Meeting at an end, the business of the Ordinary Meeting was thereupon resumed.

The List of Donations to the Society, exclusive of exchanges and reprints, received since the last meeting, was read, and the thanks of the meeting were voted to the donors.

	From
A Mahogany Box to contain the Marzoli Objective	*An Anonymous Donor.*
Leaflets 50 to 53 issued by the Board of Agriculture	*The Board of Agriculture.*
Annual Report of the Local Government Board, 1897–98. (8vo, London, 1898)	*The Local Government Board.*
Proceedings of the Indiana Academy of Science, 1897. (8vo, Indianapolis, 1898)	*The Indiana Academy of Science.*
Transactions of the Ottawa Literary and Scientific Society, No. 1, 1897–98. (8vo, Ottawa, 1898)	*The Ottawa Literary and Scientific Society.*

The Secretary called special attention to a beautifully made small box, anonymously given to the Society, and bearing the following inscription:—

An Achromatic Microscope
Objective made in 1811 by
Bernardino Marzoli.

Presented by Messrs. Trainini
Broths., May 1890.

See Journal R.M.S., 1890, page 420.

The President called attention to three exhibits. The first was a new lens by Zeiss, called a Plankton Searcher,* a water-immersion

* See this Journal, 1898, p. 678.

objective, intended as a low power for use in examining living objects in water. The instrument was used in a cylindrical glass vessel, at the bottom of which the objects were placed, and prevented from swimming out of focus by a cover-glass placed over them and resting on some glass supports; more water was then poured into the vessel, and the Microscope objective inserted in the water. The definition was exceedingly sharp. The second was a new appliance by Messrs. Zeiss, an adaptation of the Porro prism to the Microscope, providing an erector which would no doubt be found useful for dissection and other purposes. The third was a Binocular Microscope made by Leitz, sent for exhibition by Messrs. Watson and Sons. It consisted of two Brücke lenses fixed upon a bar in such a way that their axes were inclined towards each other at an angle so as to meet at the focus, their attachment being jointed so that the distance between the two tubes could be altered to suit the eyes. This was a very ingenious arrangement, and one which was likely to prove very valuable for low-power examination of large objects, or for low-power dissection.

The President said they had passed a vote of thanks to Mr. Curties at their last meeting for the loan of the instruments and exhibition of high-power objects, but he should like to say how much he was surprised on looking round after the meeting, to see such an exhibition of apochromatic objectives and valuable slides as that which was provided on that occasion. He thought it was the first time there had been a public exhibition of so many valuable objectives and objects.

Mr. Keith Lucas exhibited a new model Microscope, the design of which was to effect both coarse and fine adjustments by means of a single slide, and thereby to reduce the expensive work of planing. This was effected by means of a compound lever, a large wooden model of which was also shown.

The President, in expressing the thanks of the Society to Mr. Lucas, said it would be scarcely possible for anyone to make remarks upon this method of construction, as no one had yet seen it. The idea, however, of bringing a large model of it was, he thought, an excellent one for enabling them more easily to understand how it worked.

The President said, as there was no formal paper on the Agenda for the evening, he would call attention to some of the various types of Binocular Microscopes which were being exhibited. Amongst these would be seen the Ahrens binocular eye-piece for Microscopes, in which both tubes were equally inclined; one by Murray and Heath, in which there was one straight tube, the construction being something like that of Nachet. The Stephenson binocular was there in several patterns, and also one by Leitz. Special attention was directed to the form exhibited by Messrs. Zeiss made with the Porro prisms, and giving an erect image; this Microscope was provided with two objectives of equal power, one for each tube, and the binocular effect was very remarkable and beautiful, the stereoscopic impression of solidity being far greater than anything of the kind obtained by a divided image from one objective.

Moginic's portable binocular, the Nelson model, Wenham's binocular with high-power objective, a binocular dissecting Microscope, and a binocular Microspectroscope were also amongst the exhibits.

The President, on behalf of the Council, then made the following nominations for Officers and Council for the ensuing year, to be submitted to the Fellows for election at the Annual Meeting of the Society on January 18th, 1899.

President—Mr. E. M. Nelson.

Vice-Presidents—Messrs. Bennett, Karop, Hon. Sir Ford North, and Mr. J. J. Vezey.

Treasurer—Mr. W. T. Suffolk.

Hon. Secretaries—Rev. Dr. Dallinger and Dr. Hebb.

Members of the Council—Messrs. Allen, Beck, Dr. Braithwaite, Rev. E. Carr, Messrs. Carruthers, Comber, Dadswell, Michael, Powell, Rousselet, Dr. Tatham, and Rev. A. G. Warner.

Curator—Mr. C. F. Rousselet.

The President, on behalf of the Council, appointed Mr. E. Dadswell as one of the Auditors of the Society's accounts for the past year, and requested the Fellows present to appoint another gentleman to act in that capacity with him.

Mr. J. M. Allen was thereupon proposed by Mr. Curties, seconded by Mr. Macer, and unanimously elected.

The President said the Society had a large number of books in the library which were in need of binding, and he wished to move a hearty vote of thanks to some anonymous donors, for defraying the cost of binding a number of these; one Fellow had 100 volumes bound; and he hoped this great service to the Society would be an example which others might follow.

The thanks of the Society were cordially voted to those gentlemen by whom these volumes had been caused to be bound.

The following Instruments, Objects, &c., were exhibited:—

The Society:—Ahrens' Binocular Eye-piece for high powers; Murray and Heath's Binocular Microscope.

The President:—Zeiss' "Plankton Searcher"; and Erecting Eye-piece fitted with Porro's prisms.

Mr. Charles Baker:—Moginie's Portable Binocular Microscope; Nelson model Binocular Microscope; Stephenson's Binocular Microscope; Iris of Rabbit, injected; Ova of Toad, injected; Section of Hoof of Horse, injected.

Messrs. R. and J. Beck:—Binocular Microspectroscope, with Spectrum of Blood showing over the Sorby's Standard Scale; Wenham's Binocular Microscope with 1/8 in. Objective, showing Anthrax bacillus; Portable Binocular Microscope with low-power objective, showing Crystals of pure Dental Gold; Binocular Dissecting Microscope.

Mr. Arthur Earland:—Typical Species of Foraminifera selected from various localities.

Mr. G. T. Harris:—*Noctiluca miliaris* and *Sertularia pumila.*

Mr. E. Hinton:—Foot of larva of Goat Moth.

Mr. Keith Lucas:—A New Model Microscope.

Mr. J. Pillischer:—Large Binocular Microscope; "International" (new form) Binocular Microscope; Student's Binocular Microscope with plain Stage; Head of Human Tape-worm; a minute Ichneumon Fly, *Eulophus nemale*; a Gall Fly.

Messrs. Powell and Lealand:—*Vallisneria*, with high-power prism and 1/20 in. apochromatic water-immersion objective.

Mr. C. F. Rousselet:—Stephenson's Binocular Microscope arranged for searching and dissecting.

Messrs. J. Swift and Son:—Stephenson's Binocular Microscope, with fine adjustment.

Messrs. W. Watson and Sons:—New Binocular Dissecting Microscope by Leitz; Scientist's Binocular Microscope; Binocular Research Microscope.

Carl Zeiss:—Greenough's Binocular Microscope; Braus-Drüner Binocular Microscope.

New Fellows:—The following were elected:—

Ordinary Fellows:—Mr. Haydn McClelland and Mr. Percy Edward Radley.

ANNUAL MEETING

Held on the 18th of January, 1899, at 20 Hanover Square, W., The President (E. M. Nelson, Esq.) in the Chair.

The Minutes of the meeting of December 21st, 1898, were read and confirmed, and were signed by the President.

The President, on behalf of the Council, nominated Mr. C. L. Curties as one of the Scrutineers of the ballot; and Mr. Mainland, having been proposed by Mr. Allen and seconded by Mr. Hill, was elected Scrutineer on behalf of the Fellows. These two gentlemen then proceeded to take the ballot for Officers and Council for the ensuing year.

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 given to the Donors.

	From
Journal of the Board of Agriculture, vol. v. No. 3. (8vo, London, 1898)	*The Board of Agriculture.*
Hewlett, R. T., A Manual of Bacteriology. (8vo, London, 1898)	*The Publishers.*
Spitta, Edmund J., Photomicrography. (4to, London, 1899)	*The Publishers.*
Bowhill, Thomas, Manual of Bacteriological Technique. (8vo, Edinburgh, 1899)	*The Publishers.*

The Report of the Council for the year 1898 was read by the Secretary, as follows :—

REPORT OF THE COUNCIL FOR 1898.

FELLOWS.

Ordinary.—During the year 1898, 33 new Fellows were elected, whilst 11 have died, 17 have resigned, and 15 have been removed from the list for non-payment of subscriptions and other causes.

Honorary.—Two Honorary Fellows, Prof. G. J. Allman and Prof. F. Cohn, have died, and the vacancies caused by their deaths remain unfilled.

The list of Fellows now contains the names of 506 Ordinary, 1 Corresponding, 48 Honorary, and 83 Ex-Officio Fellows, being a total of 638.

FINANCE.

The cash statement for 1898 is in many respects much more satisfactory than that of many previous years.

Without selling out any investments, the Council has been able to meet all the year's liabilities, and also to set aside a sum of 250*l.*, now on deposit. This it is hoped will enable the Society to replace some of its investments, which had to be sold out to clear up the arrears of the liabilities of former years. The investments remain the same as last year, and amount to 1115*l.* 11*s.* 1*d.*; but to this must be added the sum of 250*l.* on deposit at the Union Bank of London.

The amount received from the sale of the Journal is larger than that of the previous year; this however does not arise from an increased sale of the Journal, but is due to an early payment by the publishers.

The contract for advertisements for 1898 is more advantageous to the Society than that of previous years, though only a moiety of the amount has yet been received.

The item of expenditure for screw tools covers a stock which the Society holds in hand for future sales.

JOURNAL.

The Summary of Current Researches in Zoology, Botany (including Bacteriology) and Microscopy has been continued in the Journal during the year as heretofore, under the Editorship of Mr. A. W. Bennett, with the assistance of several Fellows of the Society. This summary introduces to the notice of English scientific readers a fairly complete *resumé* of all observations and discoveries in zoology and botany of any importance, made throughout the world during the year, and of all new inventions and new applications in the structure of the Microscope, and of new applications and apparatus, &c., in microscopial technique.

The editorial staff has agreed to continue its work on the same conditions as have existed for the past two years.

INSTRUMENTS AND APPARATUS.

During the past year the Microscopes and apparatus have been cleaned, arranged, and labelled, and the following instruments, &c., have been added :—

(1) Culpepper and Scarlet Microscope. Presented by Mr. G. T. Harris.

(2) Two early Live-boxes by Powell and Lealand. Presented by the President.

(3) Microscope by Benjamin Martin. Presented by Mr. A. E. Fryett.

(4) Solar Microscope. Presented by the Executors of the late Mr. Henry Perigal.

(5) Mahogany box with inscription, for the Marzoli objective. Presented anonymously.

CABINET.

Eighteen slides have been presented during the year :—10 Diatomaceæ, 4 Ruled Lines, 1 Diffraction Plate, by Mr. H. J. Grayson ; 3 Vegetable Preparations, by the Treasurer. Many of the slides since they have been rendered available have been exhibited at various evening meetings.

The register of the "Old Collection" has been continued to Number 6000, leaving only the diatoms, about 1000. Mr. Comber is continuing his valuable work in the examination of the diatoms, but owing to the careful nature of his investigation, considerable time must elapse before the work is completed.

The Treasurer, as in the case of the whole collection, is carrying out the needed repairs and remounts.

In addition to the register with its makeshift index, a card has been written for each slide; these, when accommodation has been provided for their reception, will be sorted and will do temporary duty for a subject catalogue. When this has been completed, the Council will be glad of the assistance of Fellows who would be willing to assist in preparing the subject catalogues.

LIBRARY.

Owing to the generosity of two Fellows who desire to remain anonymous, 110 volumes have been bound. The Council desire to point this out, in the hope that others may follow this laudable example. A considerable expenditure on this account would be desirable.

Mr. W. T. Suffolk, the Treasurer of the Society, then read his Annual Statement of Accounts and Balance Sheet as follows :—

THE TREASURER'S ACCOUNT FOR 1898.

Dr.

1898.				£	s.	d.
To Balance from 1897				169	5	6
" Admission Fees				54	18	0
" Annual Subscriptions—						
1894	£2	12	6			
1895	4	4	0			
1896	16	16	0			
1897	40	10	3			
1898	572	13	2			
1899	21	10	6			
1900	0	2	0			
				658	8	5
" Compounding Fee				31	10	0
" Interest on Investments				37	6	6
" Sale of Journal				529	6	4
" Advertisements				30	0	0
" Catalogues sold				0	5	0
" Lists of Fellows sold				0	3	0
" Reprints sold				17	1	4
" Periodicals sold				0	15	0
" Donation, anonymous, for binding purposes				2	0	0
" Screw Tools sold				8	5	0
" Sundries				0	4	8
" Electro blocks sold				0	6	6
				£1539	15	3

Cr.

1898.				£	s.	d.
By Rent, Coals, Attendance, &c.				133	16	0
" Salaries, Reporting, Commission, &c.				161	8	6
" Books and Binding				55	11	5
" Expenses of Journal—						
Printing	£457	18	7			
Illustrations	83	19	0			
Editing	167	9	0			
				709	6	7
" Refreshments				13	10	0
" Stationery, &c.				14	10	0
" Fire Insurance				2	0	0
" Petty Cash				30	17	0
" Cost of Screw Tools				31	18	0
" Deposited with the Union Bank of London				250	0	0
" Sundry payments, Lantern, Operator, &c.				0	10	6
" Repairs				2	12	6
" Registering Bye-Laws				1	1	0
" Balance to 1899				132	13	9
				£1539	15	3

Investments, 31*st December*, 1898.

400*l*. Nottingham Corporation Stock Three per Cents.
315*l*. 11*s*. 1*d*. New South Wales Three and Half per Cents.
400*l*. North British Railway Three per Cents.
250*l*. On Deposit, Union Bank of London.

W. T. SUFFOLK, *Treasurer*.

We have examined the foregoing Account, and compared the same with the Vouchers in the possession of the Society, and verified its Securities as above mentioned, and find the same to be correct.

EDWARD DADSWELL
J. MASON ALLEN } *Auditors*.

Mr. J. M. Allen then moved that the Reports of the Council and of the Treasurer, together with the Balance Sheet for the year 1898, be received and adopted, and that they be printed and circulated in the usual way.

Mr. Richard Smith having seconded the motion, it was put to the meeting by the President, and unanimously carried.

The Scrutineers having handed in their report, the President declared the following gentlemen to have been duly elected as Officers and Council of the Society for the ensuing year.

President—Edward Milles Nelson, Esq.

Vice-Presidents—*Alfred W. Bennett, Esq., M.A., B.Sc., F.L.S.; *George C. Karop, Esq., M.R.C.S.; The Hon. Sir Ford North; J. J. Vezey, Esq.

Treasurer—William Thomas Suffolk, Esq.

Secretaries—Rev. W. H. Dallinger, LL.D., F.R.S.; R. G. Hebb, Esq., M.A., M.D., F.R.C.P.

Twelve other Members of Council—*James Mason Allen, Esq.; Conrad Beck, Esq.; *Robert Braithwaite, Esq., M.D., M.R.C.S., F.L.S.; Rev. Edmund Carr, M.A., F.R.Met.S.; *William Carruthers, Esq., F.R.S., F.L.S., F.G.S.; T. Comber, Esq., F.L.S.; Edward Dadswell, Esq.; *A. D. Michael, Esq., F.L.S.; Thomas H. Powell, Esq.; Charles F. Rousselet, Esq.; John Tatham, Esq., M.A., M.D., F.R.C.P.; Rev. A. G. Warner, M.A.

Curator—Charles F. Rousselet, Esq.

The President then read his Annual Address, the first portion being a review of the work of the past year, and the second portion being a paper on Dispersion, in the course of which he discussed some formulæ necessary in constructing achromatic lenses; diagrams and tables in illustration of the subject being shown upon the screen.

Mr. A. D. Michael said they had listened with great pleasure to the address which the President had given them, and which he had called a summary; doubtless they would soon be able to have it before them *in extenso*. The mathematical calculations involved in questions of dispersion and refractive index were not things which could be grasped in a moment by the man in the street, or indeed by any person who had not previously given much attention to the subject; but they were addressed to a Microscopical Society, and one of the very first objects of that Society was to increase the perfection of the instrument. In no respect was perfection more necessary or important than in the knowledge of dispersion and refraction. He believed he was right in saying that no one in this country was a more thorough master of the subject than the President. Amongst the many admirable addresses which had been delivered before the Society during its existence of over half a century, he felt sure that the one which they had heard that evening would take a very high place. He had much pleasure in proposing

* Those with an asterisk (*) had not held during the previous year the office to which they were elected.

that a very hearty vote of thanks be given to the President for his address, and that he be asked to allow it to be printed in the Journal.

Mr. Gifford said he had been engaged for some time in measuring the refractive indices of various substances, and Mr. Nelson had, in his address, put before them a way in which the thing might be done very much more easily than had been possible before. The ordinary method was to take each measurement from three points in a circle, and if the spectrum contained a great number of lines, a great deal of time would be taken up and the process became very tedious, since five or six measurements had also to be taken at each point to get a proper average. Now, however, it was only necessary to measure two lines, after which Mr. Nelson's formula was applied, and the thing was done. He should like to ask Mr. Nelson how far he had carried his experiments? In the series of measurements put before them, only five or six lines had been taken—the Jena table gave five, and Chance's gave two or three only. These ranged from A in the spectrum to G, but the spectrum had been explored much farther into the red, and at the other end into the ultra-violet as far as 1852·2, the extreme line of aluminium discovered by Sir G. G. Stokes; and he was very much interested to know how far this method would go, and if Mr. Nelson had taken the wave-lengths below A or above G. He was sure they would all appreciate the amount of labour which Mr. Nelson had bestowed upon this subject.

Mr. Karop said he should like to be allowed to second the motion of Mr. Michael that the thanks of the Society be given to the President for his very able address, and that he would allow it to be printed and published in the Journal of the Society in the usual way.

Mr. Michael then put the motion to the Meeting, when it was unanimously carried by acclamation.

The President said he could only thank Mr. Michael for proposing, Mr. Karop for seconding, and the Fellows of the Society for the very kind way in which they had given him such a cordial vote of thanks.

Mr. J. J. Vezey thought the Fellows present would agree with him that the Annual Meeting afforded a very pleasant opportunity of expressing the indebtedness of the Society to its Honorary Officers for the way in which their work had been carried on during the past year, and he had therefore very great pleasure in proposing that the best thanks of the Fellows be given to the Honorary Secretaries and the Treasurer. The Fellows of the Society had had some opportunity of seeing how well Dr. Hebb had carried out the duties of a Secretary at the Ordinary Meetings; but only those who were upon the Council knew how great an amount of time and energy he had given to the work. Dr. Dallinger, they were pleased to know, had so far recovered his health as to be able to come amongst them more often during the past year. They were very glad indeed to see him at the meetings, and to have the benefit of his advice and help at the Council Meetings. With regard to the Treasurer, the Report he had read that evening would speak for itself, but in addition to keeping the accounts in better order than they had been for years, he had, as mentioned in the Report, done very great service to the Society in preserving and remounting a large number of slides in the cabinet. He (Mr. Vezey) would like also to include in this vote the Honorary Curator, Mr. Rousselet, whose duties had only commenced in the past year, but who had already done most excellent work which would be of great value to the Society in the future.

The motion having been seconded by the Rev. A. G. Warner, was put from the chair and carried unanimously.

Dr. Hebb, on behalf of himself and his colleagues, thanked the Fellows of the Society for the kind way in which they had received this vote of thanks.

A vote of thanks to the Auditors and Scrutineers was then proposed by Mr. Watson Baker. Seconded by Mr. Macer, and unanimously carried.

New Fellows.—The following gentlemen were elected *Ordinary* Fellows of the Society:—Mr. Claude St. Aubyn Farrer, Dr. Moses Drury Hoge, junr., Lieut.-Colonel C. W. Sherrard.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

APRIL 1899.

TRANSACTIONS OF THE SOCIETY.

III.—*The President's Address.*

By Edward M. Nelson.

(*Delivered January 18th,* 1899.)

I have a pleasant duty to perform before beginning my Address, viz. to thank you most sincerely for the quite unexpected honour you have conferred upon me by electing me your President for the third year. Although, when first taking this chair, I was forced by the conditions which then existed to speak in a somewhat pessimistic strain, I am now happy to say that those conditions, owing to the untiring efforts of your Council, have passed away, and I need not reiterate what you have already learnt from the Report of your Council, that we have entered upon a new life of prosperity and, I trust, usefulness.

You must have been pleased to hear from the Report of your Treasurer that this year a balance takes the place of a deficit; this, coupled with the statement that all liabilities outstanding at the close of the financial year have been met, must be regarded as very satisfactory.

You must remember that this gratifying result is in no small measure due to the kind offices of Mr. Bennett, Prof. Thomson, and Dr. Hebb, who have for a second year devoted so much of their valuable time to the interests of the Society. The abstracts in the domains of Zoology, Botany, and Bacteriology still maintain their high state of efficiency, and I am sure those interested in "Microscopy" will have noticed the very able extracts sent to us by Mr. Disney, and the general improvement of this part of the Journal.

Your records show that a larger number of new Fellows have been elected during the past year than in the previous one, and that there has been an increase in the number of Fellows attending the meetings, as well as of visitors, which we may take as a sign that the subjects brought forward at the meetings have not been devoid of interest.

The special thanks of the Society are due, not only to your Sub-committee who watch over this by no means easy part of our work, but also to those opticians who have so kindly brought here a large number of their beautiful instruments to exhibit the objects.

It is also satisfactory to note that the number of papers read before the Society has largely increased.

Your Cabinet of Instruments and Apparatus has been overhauled, set in order, and catalogued by your Curator, Mr. Rousselet, to whom the thanks of the Society are specially due. Your Treasurer has again this year devoted much of his time to your Cabinet of Objects.

At our last Annual Meeting I remarked that a large number of the books in our Library were unbound; it is now my pleasing duty to thank the anonymous donors, whose generosity has enabled us to bind no fewer than 110 volumes.

Before proceeding with the work of the past year, allow me to acknowledge the assistance I have received from the Officers and Council in the work of the session. I am only expressing the views of the Council in thanking Mr. Parsons for the able manner in which he has discharged his several duties. During the past year we have lost our last original Fellow, Mr. John Van Voorst, who was elected a Fellow of this Society no less than 59 years ago. The senior Fellow now on our list is Mr. G. Shadbolt, elected a Fellow in 1845, and President in 1856.

In the past year we have had the concluding portion of Mr. F. Chapman's valuable monograph on the 'Foraminifera of the Folkestone Gault'; and three papers on 'Foraminifera,' by Mr. A. Durrand. An important paper on 'High Refractive Mounting Media' was given to us by Mr. H. G. Madan, who, you will be sorry to hear, has lately met with a very serious accident.

You have received a valuable present from Mr. H. J. Grayson, of Melbourne, of micrometric rulings, mounted in a high refractive medium, the refractive index of which is as great as that of a diamond, viz. 2·549. This subject is of so great importance that special attention must be given to it. This importance is twofold, first the medium, secondly the rulings. Taking the medium first, the original best known medium was that invented by Prof. Hamilton Smith; his slides, however, were variable, some being stable, while others were not so; he was followed by Dr. Van Heurck, who used the same material with the same results.

The next we had was by the Rev. Father Thompson, whose original slide is in my possession, and is still good. Some years later, Father Thompson published his formula, but those who have followed it have not been equally successful. In these experiments I strongly suspect it is a case of the man behind the gun. The late Dr. Meates was an early worker in dense media; he used various formulæ of his own, some of which were highly successful, while others were not so.

Now we come to Mr. Grayson's, which are said to be on a new formula (not published), and which are quite permanent. There can be no doubt that both the diatoms and the rulings mounted in it show up in a very superior manner. Now, with regard to the micrometric rulings, the most important of the slides he has so kindly presented to the Society is the one which contains 100ths and 1000ths of an inch, and 10ths and 100ths of a millimetre. I have very carefully micrometrically measured these rulings, with an oil-immersion 1/8 of 1·43 N.A. and a very fine micrometer eye-piece by Powell.* Taking the ruling of ·001 in. first, we find that the mean for the ten ruled spaces gives a micrometric value of 450·25 divisions of the screw-head. The difference between this mean and the widest space was +1·25 divisions, and the least was −1·25. Now, as the value of one division is 1/450,250 in., the maximum and minimum error in each case is 1/360,200 in. This may seem to some ridiculous; but allow me to state that a half of a single division made a difference that could be perceived. Therefore it appears that while with the best microscopical appliances of the present day, you cannot separate a quantity less than, say 1/120,000 to 1/130,000 in., yet you can measure inequalities in larger objects, certainly up to 1/500,000 in., and probably less, as half a division of my micrometer meant, under the conditions in which it was used, 1/900,000 in.

Now, with regard to the millimetre rulings, we find that they are remarkably accurate; the maximum differences from a mean of $354 \cdot \dot{7}$ for ·02 mm., being only $+1 \cdot 7\dot{2}$ and $-1 \cdot 2\dot{7}$. As the value for one micrometer division is ·05637 μ, the maximum and minimum errors are +·097 and −·072 μ respectively. With regard to the ratio between the inch and millimetre scales, we have

$$\frac{4502 \cdot 5}{177 \cdot 3\ddot{8}} = 25 \cdot 3821.$$

Now the value of the inch, when compared with the metre,† both being at a temperature of 62° F., is 25·3999779; we see, therefore, that Grayson's has slightly too small a ratio.

To illustrate the advance we have in Mr. Grayson's micrometer, an old one was measured, and the difference between the maximum and minimum values was found to be no less than 1/16,271 in.—a very different result.

When Mr. Grayson's millimetre rulings were compared with those by Mr. Rogers, it was found that they came out very favourably. Unfortunately, Mr. Rogers' scale is mounted dry, and has sweated considerably, consequently the measurements could not be carried to such a fine point as before. Mr. Grayson's rulings being

* Journ. R.M.S., 1890, p. 510, and Carpenter on 'The Microscope,' 7th ed., p. 229, fig. 177.

† Results as obtained by measurements made by order of the Board of Trade in 1896.

mounted in a dense medium, stand out clearer and sharper than those which have been plumbagoed and mounted in balsam. The Society must be congratulated on possessing such a fine standard for micrometrical measurements.

A new form of camera has been introduced by Messrs. Swift and Son. Cameras may be divided broadly into two kinds: first, those suitable for a Microscope when used in a horizontal or nearly horizontal position; secondly, those for use when the Microscope is in a vertical or nearly vertical position. In the first group we have those of Wollaston, Beale, and their modifications; in the second, those of Abbe and several others. The Abbe form was invented by Mr. G. Burch in 1878, as an alternative arrangement for his micrometer.* (Let me again express my astonishment that this efficient, simple, and inexpensive arrangement of Burch's micrometer is not supplied by our opticians. A device so eminently practical could not but command a large sale among biologists and students.)

Swift's camera differs from that of Abbe in two points: first, instead of the oblique side of the prism being opaquely silvered, with a hole in it, in Swift's it is very lightly silvered, so that it is semi-transparent and no hole is required; secondly, the large plane mirror of the Abbe camera is replaced by a small right-angled prism, the hypotenuse of which is silvered. The advantage of the semi-transparent silvered film in Swift's camera is, that it tones down the light in the Microscope, and no extra screen is required; also the small prism is far lighter than the large plane mirror, all strain, therefore, at the eye-end of the body of the Microscope is removed.

Messrs. Zeiss have exhibited here a new lens called a "Plankton Searcher," a lens suitable for the examination of wandering or roaming objects (πλάζω, to wander or roam). It is a low-power water-immersion of 1·3 in. focus and ·11 N.A. aperture. This lens is practically apochromatic, and its definition is exceedingly sharp and bright; the illumination, owing to the greater refraction of the water, is greater than that of an ordinary dry lens of the same diameter in the proportion of $1:1\frac{3}{4}$. A good method of illuminating objects for examination with this lens is to focus, by means of a bull's-eye, the image of the flat of the flame of a paraffin lamp upon them through the side of the cylindrical glass vessel, by which means an excellent velvety dark ground can be obtained. Let me express a hope that this lens is only the first of a series, and that its success will encourage the firm of Messrs. Zeiss to extend both the powers and apertures. The bottom of the glass vessel is optically worked; it is therefore advisable to gum beneath it a circular edging of paper, to prevent it becoming scratched by contact with the metal stage.

There is one other important departure during the past session to be noted, viz. the improvements that have been effected in cheap student's Microscopes by Messrs. Beck and Watson. I can perfectly

* Journ. Quekett Micr. Club, v. (1878) ser. i. p. 45.

well remember the form of the student's instrument when I first took up the Microscope. The student's Microscope of that day consisted of a very short tube Hartnack, with a very bad direct-acting screw fine-adjustment, a push-tube coarse-adjustment, a stage with a small hole in it, no substage or condenser of any kind, a concave mirror, a bull's-eye fixed to the limb for superstage illumination, a separating objective composed of three French buttons, and two eye-pieces, packed in a box.

Messrs. Swift and Son were the first in this country to alter this state of things. They brought out a better made Microscope, mounted on a bent claw foot, fitted with cheap objectives of a far superior quality, both with respect to power and aperture. Being much struck with the improvements they had effected, I instructed them to make for me a similar instrument, fitted with a rack-and-pinion coarse adjustment and a condenser. This, I believe, was the first student's Microscope, properly so called, that had a rackwork coarse-adjustment, and a very efficient instrument it proved to be. It was with this instrument that the beaded structure of tubercle bacilli was first demonstrated, on May 23rd, 1882.

Since that time, however, improvements in the student's Microscope have gone on apace, culminating in the fine models you have had exhibited before you during the past session. Almost all student's Microscopes now have rackwork coarse adjustments, and many are fitted with substage condensers of some form or other. Messrs. Watson have fitted to their student's Microscope a lever fine-adjustment on a thoroughly sound principle, thereby raising it to the position of a Microscope that can, for the first time with truth be called "good enough for histological purposes."

Dispersion.

It will be in the recollection of the Fellows that the subject of my previous Address, selected for your kind consideration, was far too extensive to be dealt with on that occasion; therefore only a review of what was termed "the middle portion" was placed before you. To-night I propose to introduce briefly and inadequately the "first portion," viz. Dispersion. This, in itself a very large subject, has occupied the attention of many eminent mathematicians, physicists, and opticians; still the last word has not been spoken; for it is admitted by the ablest writers that as yet all the phenomena have not been fully explained, neither is the matter fully understood.

It is not my intention to push the inquiry any further into the unknown, even if I were qualified to do so, which I am not; but I shall endeavour to put some of the received facts before you this evening in what probably is a new and original dress, which I hope may prove helpful to those who are anxious to know something of dispersion, and yet have neither the time nor the opportunity to study the larger treatises on the subject.

Now, a spectrum may be produced by diffraction or refraction, but there is an important difference between those spectra; for in the diffraction spectrum the angular displacement of any particular portion of the diffracted beam is always proportional to the wave-length; but this is not the case with that obtained by refraction. For example, if we take two beams of light, one consisting of waves measuring from 7000 to 6000 tenth-metres, the other of waves measuring from 5000 to 4000, and cast diffraction spectra of them upon a suitable screen, then if we suppose that the spectrum arising from the light consisting of the longer waves is 1 in. long, the spectrum of the light having the shorter waves will also measure 1 in.

But under similar circumstances a refraction spectrum from a glass prism would be of very different proportions; for if the spectrum arising from the light of the longer waves was still 1 in. long, that from the shorter waves would measure more than 1 in., and further, different kinds of glass would yield different proportions. In brief, the character of the dispersion in a refraction spectrum varies with the nature of the substance from which that dispersion is obtained, and this is the point that is of such importance in lens construction.

Dispersion is measured by the difference of the refractive indices of the various Fraunhofer lines. In order to illustrate this, and other points to be dealt with later, an extract is appended from Messrs. Schott and Co.'s Jena catalogue of optical glasses, which is the most comprehensive and best arranged table as yet published.

The next table is that of wave-lengths for the various Fraunhofer lines in inches and tenth-metres with reciprocals. A′ is the potassium line near the Fraunhofer line A, and G′ a hydrogen line near G.

The following is an explanation of Table I. In order to find ν, the reciprocal of the dispersive power, you divide the figures in the first column, less one, by those in the second column. The method of finding the refractive indices for lines other than D is obvious: thus, to find that for A′, subtract the upper figures in column 3 from those in column 1; to find that for F, add the upper figures in column 4 to those in column 1; to find that for C, subtract those in column 2 from the sum just obtained; G′ is found by adding the upper figures in the 5th column to the refractive index of F.

The small figures below the others in the 3rd, 4th, and 5th columns are obtained by dividing those immediately above them by the figures in the 2nd column. It was pointed out in my previous address that ν, the figures in the last column, represented the foci of positive and negative lenses which when combined would make an achromatic combination; it is obvious therefore that in selecting two glasses suitable for this purpose, we must take care to have a sufficient amount of difference between them; thus, for example, if we were to use the first two glasses in the list, we should only have a dispersive ratio of $1 \cdot 02 = \frac{\nu}{\nu'} = n'$; the focus of the combination would there-

TABLE I.

Name of Glass.	Refractive Index for D Line.	Dispersions.				ν Reciprocal of Dispersive Power.
		$\mu_F - \mu_C$	$\mu_D - \mu_{A'}$	$\mu_F - \mu_D$	$\mu_{G'} - \mu_F$	
Dense barium phosphate crown	1·5760	·00884	·00570 ·644	·00622 ·703	·00500 ·565	**65·2**
Boro-silicate crown	1·5100	·00797	·00519 ·651	·00559 ·701	·00446 ·559	**64·0**
Calcium silicate crown	1·5179	·00860	·00553 ·643	·00605 ·703	·00487 ·566	**60·2**
Silicate glass	1·5368	·01049	·00659 ·628	·00743 ·708	·00610 ·582	**51·2**
Borate flint	1·5736	·01129	·00728 ·645	·00795 ·704	·00644 ·571	**50·8**
Ordinary silicate flint	1·6202	·01769	·01034 ·605	·01220 ·714	·01041 ·609	**36·2**
Dense silicate flint	1·6734	·02104	·01255 ·597	·01507 ·717	·01302 ·619	**32·0**

Note.—The last figures in the third and fourth columns ought to be ·596 and ·716 respectively; there are also differences in other terminal figures, but the table is given as it is printed in the Jena Catalogue.

TABLE II.

Line.	Wave-length in inches.	Wave-length in tenth-metres. λ_x	Reciprocal of Wave-length in tenth-metres × 1000. L_x	—
A′	$\frac{1}{33086}$	7677·0	·1302592	
B	$\frac{1}{36971}$	6870·19	·1455564	
C	$\frac{1}{38702}$	6563·05	·1523681	
D	$\frac{1}{43102}$	5893·0	·1696929	Middle of D lines.
D_2	$\frac{1}{43122}$	5890·18	·1697741	
	$\frac{1}{45000}$	5644·44	·1771655	Point of maximum visual brightness.
E	$\frac{1}{48193}$	5270·5	·1897353	
F	$\frac{1}{52247}$	4861·5	·2056978	
G′	$\frac{1}{58512}$	4341·0	·2303617	
H_1	$\frac{1}{64002}$	3968·62	·2519767	

fore be exceedingly long, and a lens for practical work would require to have curves of excessively short radii. In order to obtain radii suitable for practical constructions, it is necessary to choose glasses having a dispersive ratio of 1·25 and upwards, unless the lens be required of very long, or even of infinite, focus for purposes of correction.

Now, with regard to the small figures printed below the others, they are for the purpose of estimating the amount of secondary spectrum left outstanding in the combination.

The presence of a secondary spectrum is owing to irrationality in the dispersion. To illustrate this, let us suppose that we have a flint, the dispersion of which between B and E is precisely double the dispersion of a certain crown between the same limits. Now, if the dispersion of this flint between E and H is also double that of the crown between those limits, no secondary spectrum will be present. But no glasses as yet manufactured possess this quality; for suppose the dispersion of a flint is 3 times that of a crown between the limits of B and E, it may be 4 times that of the crown between E and H. It is therefore to this want of proportionality in the dispersions of the two glasses that the irrationality of the spectrum is due. We shall best understand the value of the small figures if we take a silicate crown and flint from Table I. for the construction of an achromatic doublet, say for example the 3rd and 6th on the list; then the focus of the positive lens will be 36·3 and that of the negative 60·2, the dispersive ratio, or n', being $\frac{\nu}{\nu'} = 1 \cdot 66$. Now let us examine the small figures below the dispersions, and see the state of the secondary spectrum by subtracting the values for the crown from those for the flint, thus:

Flint	605	714	609	
	643	703	566	$n' = 1 \cdot 66.$
	− 38	+ 11	+ 43	

Again, let us take the 4th and the 7th in Table I., we have foci of 32·0 and 51·2 respectively, the ratio being 1·6, and the secondary spectrum better than before, a very fair result considering the large value of n'.

Flint	597	717	619	
Crown	628	708	582	$n' = 1 \cdot 6.$
	− 31	+ 9	+ 37	

This might have been expected; for as a general rule the amount of the secondary spectrum increases with the increase in the value of n', for example:

Flint	600	715	615	
Crown	651	701	559	$n' = 1 \cdot 89.$
	− 51	+ 14	+ 56	

Nevertheless a good deal may be done by a careful selection of suitable pairs, thus:

Flint	606	713	607	
Crown	642	704	568	$n' = 1 \cdot 55.$
	− 36	+ 9	+ 39	

Another pair, the same flint combined with a different crown:

Flint	606	713	607	
Crown	633	705	571	$n' = 1 \cdot 56.$
	− 27	+ 8	+ 36	

Here by judicious selection we have not only obtained an increase in the value of n', but have also secured a more favourable condition in the secondary spectrum.

If, however, we make use of some of the newly made substances, we shall obtain a better result still. Take, for example, the 1st and the 5th in Table I., we have foci of 50·8 and 65·2 giving a dispersive ratio of 1·28, thus:

Flint	645	704	571	
Crown	644	703	565	$n' = 1 \cdot 28.$
	+ 1	+ 1	+ 6	

Here the secondary spectrum has almost disappeared.

Now, with regard to the importance of n', we saw in my last Address that $1 - n' = f'$, f' being the focus of the negative lens, when the focus of the combination was equal to 1·0. The radius of the contact curve, when the contact curves are identically the same, and the negative lens is a plano-concave, is equal to $(\mu' - 1) f'$ or $(\mu' - 1)(1 - n')$, consequently the value of n' is an index of the flatness of the contact curve; it will necessarily vary also with the value of μ', but then the limits of the variation of μ' are not large. In general therefore, the greater the value of n' the flatter is the contact curve, and we have seen that as a rule the greater the value of n' the greater will be the amount of secondary spectrum present. Further, as steep curves are synonymous with spherical aberration, we see that aplanatism or flat curves are antagonistic to achromatism. Thus it would be easier to aplanatise a doublet made of the $n' = 1 \cdot 89$ pair of glasses, because of the flatness of their curves, but here we have very imperfect achromatic conditions; on the other hand, the $n' = 1 \cdot 28$ pair have favourable achromatic conditions, but then the curves of the doublet will be steep, and therefore not so suitable for aplanatism. In some instances, when the contact curves are the same, the formula for aplanatism gives imaginary roots; this means that under those conditions perfect aplanatism is impossible.

These statements must, however, be taken with certain limitations. For example, in a telescope objective, where the ratio of $\frac{\text{focus}}{\text{aperture}}$ varies from say 10 to 15, n' may be small; but in lenses employed in the Microscope, this ratio sometimes equals 1·0, and then n' must be large.

Before passing on, allow me to give one further illustration with regard to choosing a pair of glasses for an achromatic doublet.

Suppose we wish to construct a plano-convex doublet whose contact curves are similar, and in which the positive lens shall be an equi-convex, what glasses must we employ? Going back to the fundamental equation for achromatism $\frac{1}{\nu f} + \frac{1}{\nu' f'} = 0$, we have $\nu f = - \nu' f'$. Let r and s be the radii of the equi-convex lens whose focus is f, and r' that of the plano-concave whose focus is f', then putting the radii in place of the foci in the equation, we have, neglecting the sign,

$$\frac{\nu' r'}{\mu' - 1} = \frac{\nu s}{2 (\mu - 1)};$$

but $r' = s$; therefore

$$\frac{2 \nu'}{\mu' - 1} (\mu - 1) = \nu.$$

Next let us choose a flint likely to suit our purpose; if we want flattish curves we know that ν' must be small, therefore let us take the last glass in Table I., this has $\nu' = 32 \cdot 0$ and $\mu' = 1 \cdot 6734$.

Then

$$\frac{2 \nu'}{\mu' - 1} = 95 \cdot 04.$$

And $$95 (\mu - 1) = \nu.$$

Now by means of an ordinary slide-rule we can try the glasses in the catalogue, and in a few minutes see if there is one in the list that will, when combined with the flint which we have chosen, suit our purpose. The method of search is as follows:—Set 95 as a multiplier, and the $\mu - 1$ of any glass to be tried as a multiplicand, then if the product, as shown by the slide-rule, is equal to the ν belonging to that glass, as printed in the list, we have found what we wanted, but if it is not equal we must try again. For example, let us try the borate flint, the last but two in Table I.; here the multiplicand $\mu - 1 = \cdot 5736$, the slide rule gives $54 \cdot 5$ as the product, but Table I. says that $\nu = 50 \cdot 8$, therefore this glass will not do; moreover it shows that we have too large a quantity for our multiplicand. Looking now in the list for a smaller value of $\mu - 1$, we can try the next glass above it in Table I., and put 5368 for the multiplicand, the slide rule shows the product to be $51 \cdot 2$, which is the same value as the ν given in the Table, and this denotes that we have found the glass we require. Consequently, by this very simple method we have found in a minute or two a pair of glasses that fulfil the given conditions. You will observe that the formula has been framed in such a manner that only one "set" of the slide-rule is required, and the various products can be read off one after another in less time than it would take to write them down.

The glasses in Case 2, Example 4 (fig. 15), in my former Address were selected in this manner. A triple constructed of these two glasses, having two equi-convex lenses enclosing a double concave (fig. 17), will have all its radii alike, and a triple of the other kind (fig. 18), viz. two flint menisci enclosing an equi-convex, will have the outer curves double the radii of the contact ones.

We will now pass on to the main point of this paper, which will treat of dispersion formulæ. A dispersion formula has for its object the completion of the dispersion curve when only a portion of it is given. If the dispersion curve were a conic section, say a parabola or a hyperbola, the problem would be an easy one; but because the curve is of no known mathematical form, it is one of exceptional difficulty. Dispersion formulæ may be used in two ways, either for interpolation or extrapolation. Interpolation means that the refractive index of the line sought lies between those given, and extrapolation that it is beyond them. For an example of interpolation, let B, C, and H be given, find E; and for extrapolation, B, C, and D being given, find H.

Extrapolation is the true test of the accuracy of a dispersion formula; for some dispersion formulæ will work well enough when used for interpolation, but altogether break down when used for extrapolation. The problem has been attacked by many eminent mathematicians, but as yet no satisfactory solution has been found.

One of the best known dispersion formulæ, owing to its being quoted in nearly every text-book, is that of Cauchy, but it is so inaccurate as to be quite useless for practical purposes; moreover it is very laborious to work out. It is as follows: Let μ be a known refractive index, and λ its corresponding wave-length, then

$$\mu = a + \frac{b}{\lambda^2} + \frac{c}{\lambda^4} + \frac{d}{\lambda^6};$$

$$\mu_1 = a + \frac{b}{\lambda_1^{\,2}} + \frac{c}{\lambda_1^{\,4}} + \frac{d}{\lambda_1^{\,6}};$$

$$\mu_2 = a + \frac{b}{\lambda_2^{\,2}} + \frac{c}{\lambda_2^{\,4}} + \frac{d}{\lambda_2^{\,6}};$$

$$\mu_3 = a + \frac{b}{\lambda_3^{\,2}} + \frac{c}{\lambda_3^{\,4}} + \frac{d}{\lambda_3^{\,6}};$$

Here we have four known refractive indices corresponding to four given wave-lengths, consequently we can determine the value of the four unknown quantities a, b, c and d. When once a, b, c and d have been determined for any particular kind of glass, any other value of μ for any given wave-length λ_x can be easily found, thus

$$\mu_x = a + \frac{b}{\lambda_x^{\,2}} + \frac{c}{\lambda_x^{\,4}} + \frac{d}{\lambda_x^{\,6}}.$$

The accuracy of any dispersion formula may be tested for any particular glass by comparing the interpolated or extrapolated values with those actually measured by a spectrometer. This has been done, and an error has often been found in Cauchy's formula in the third decimal place.

There is another dispersion formula, by Watts; it also is tedious to work out, and it is not more accurate than that of Cauchy; space, however, does not permit me to enlarge further upon it.

I have designed a new dispersion formula which, although not absolutely accurate, gives better results than either of the preceding; it is only suitable for extrapolation, but it requires only two refractive indices to be known; further, the work required is not a tithe of the former.

In the 'Proceedings of the Royal Society' for June 1877, the late Dr. J. Hopkinson gives two tables of the refractive indices of seven of Messrs. Chance's glasses, the ν values of which vary from about 60 to 30. The measurements of these glasses were made with a spectrometer constructed by Mr. Howard Grubb; the objectives of the collimator and telescope were of 2 in. aperture, and the arc 15 in. diameter, divided to 10′, reading * by two verniers to 10″. The first Table, which we will call "Table A," contains the "most probable value of μ," according to Dr. Hopkinson's views; this may, however, be termed a hotch-potch, because the values are partly observed, partly calculated by Cauchy's formula (lines B, F, and H being used), and partly graphically interpolated. The second "Table B," which to my mind is one of the most valuable tables published, contains the values of μ to 6 places of decimals, as observed by the spectrometer. The first five glasses had three angles measured, the sixth one, and the seventh two (the H line in the seventh glass not being given). Therefore, as regards the first five glasses in "Table B," we have probably the most accurate list of refractive indices in existence.†

Notwithstanding the great weight which must be attached to any opinion issuing from so eminent a physicist as Dr. Hopkinson, you will probably agree with me that the value of "Table A" stands or falls with the accuracy of Cauchy's formula. Now, since the publication of "Table A," Cauchy's formula has been shown to be wholly unreliable; this both Mr. Gifford, whose excellent spectroscopic work is well known, and I, have on more than one occasion verified; consequently the importance of "Table A" is considerably diminished.

Perhaps it ought to be explained that the *raison d'être* for "Table A" is to round off the wobbles in the curves in "Table B" arising from instrumental and other errors.

The problem I set myself was to construct a formula that, while not laborious to work out, would, when the refractive indices of C and D_2 were given, enable one to calculate those of B, E, F, G′, and H_1 without an error appearing within 4 decimal places.

With respect to "Table A," I have been completely successful, but,

* It should be noted that an error of + 10″ in the measurement of a deviation of 40°, when the angle of a 60° prism is accurately known, will occasion an error in the refractive index of + ·000031; and an error of + 10″ in the measurement of the above prism, when the deviation is correctly known, will give an error in the refractive index of — ·000033.

† This valuable "Table B" has somehow been overlooked by all writers, while "Table A" has been frequently quoted.

owing to what has been said above, I do not propose to inflict the formula or any particulars regarding it upon you. With regard to "Table B," I have been partially successful, to the extent that out of the 34 lines calculated, only 4 contain an error in the fourth decimal place, while 27 have it in the fifth, and the remaining 3 in the sixth. Of the four which have an error in the fourth decimal place, it only amounts to a single unit in three of them. Now, considering the wobbles that are known to exist in these curves, the above results cannot be called altogether bad. (See last Table.)

To compare my formula with that of Cauchy, I worked out one line in one of the curves most free from wobbles, and the error came out in the third decimal place, and was 44 times greater than that given by my formula.

Cauchy's formula was used in the same way as mine, viz. for extrapolation, but four lines, B, C, D_2, and E, were required to be known as against the C and D_2 in my formula. The time the sum took to work out was unfortunately not noted, but it took probably nearly as long to calculate the one line by Cauchy's formula as it did the whole 34 by my formula.

It may here be stated that my formula has been tried neither on fluid media nor on mineral substances, and it is quite impossible to foretell how it would work, as the curves of some fluids and minerals are of a very peculiar nature, and have little in common with those of glasses; but I have confined my investigations solely to Dr. Hopkinson's two tables, which are distinguished in this paper by the letters A and B.

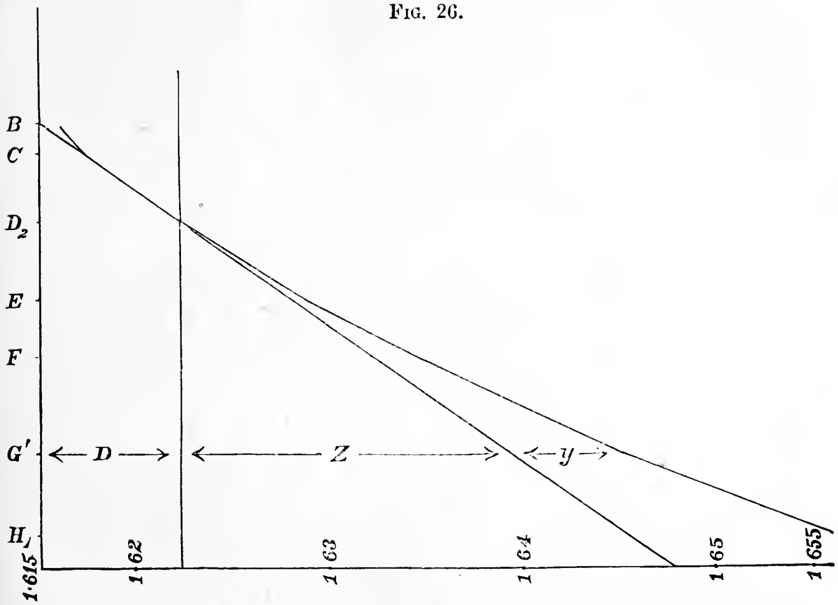
The construction of a dispersion formula is a matter of extreme difficulty, and the examination, collation, and arrangement of a vast number of abscissæ values of the curves, which take up a considerable amount of time, are merely preliminary stages of the business.

It now only remains for me to give you the formula, by which the refractive indices of the lines B, E, F, G′, and H_1 were calculated, when those of C and D_2 were given. The results of the work are tabulated, a list of the errors given in the last Table, and a copy of Dr. Hopkinson's "Table B" is appended for reference.

The subjoined fig. 26 exhibits the curve of the glass "Dense flint," and shows the method of the calculation. The ordinates are the reciprocals of the wave-lengths (tenth-metres), multiplied by 1000 for the purpose of eliminating the cyphers; the abscissæ are the refractive indices; the straight oblique line is the C D_2 ratio, from which the curve departs as we proceed higher up the spectrum (towards the blue). Z is the distance between this oblique line and the D_2 line, which, of course, runs parallel to the ordinate; *y* ought to be the exact distance of the curve from this oblique line, and the tabulated error (last Table) shows the excess or default of this quantity.

Fig. 26 is inserted merely to pictorially illustrate this subject. I may, however, state that graphic tracings of the curves were not employed in the construction of the formula; for if they were of sufficient size to exhibit the error, they were too large for synoptical purposes, and smaller than that they were simply useless.

Fig. 26.



Gentlemen, I thank you for the very kind attention you have given me while discussing this very dry and far from popular subject. Believe me, however, it is one that is of primal importance in optics, and, *ex necessitate*, one closely connected with microscopy.

Formula.

$$\text{Let } L_x = 1000\frac{1}{\lambda_x}; \qquad N = \frac{\mu_{D_2} - 1}{3 \cdot 5\,(\mu_{D_2} - \mu_C)}$$

$$Z = \frac{L_x \backsim L_{D_2}}{L_{D_2} - L_C}(\mu_{D_2} - \mu_C)$$

$$Y = \frac{\{38 \cdot 2\,(L_x \backsim L_{D_2}) + \cdot 12\}^2}{(N - 17\,L_x)^2}.$$

For lines higher up the spectrum than D_2 (towards the blue)

$$\mu_x = \mu_{D_2} + Y + Z.$$

For lines lower down the spectrum than C (towards the red)

$$\mu_x = \mu_{D_2} + \frac{Y}{10} - Z.$$

In the last Table the asterisk stands for four cyphers, and the dagger for three. Example: Hard Crown F line reads, $-\cdot 000028$; and Light Flint H_1 line, $+\cdot 000123$.

Table B.

Lines.	Hard Crown.	Soft Crown.	Extra Light Flint.	Light Flint.	Dense Flint.	Extra Dense Flint.	Double Extra Dense Flint.
B	1·513624	1·510918	1·536450	1·568558	1·615704	1·642894	1·701080
C	1·514571	1·511910	1·537682	1·570007	1·617477	1·644871	1·703485
D_2	1·517116	1·514580	1·541022	1·574013	1·622411	1·650374	1·710224
E	1·520324	1·518017	1·545295	1·579227	1·628882	1·657631	1·719081
F	1·523145	1·520994	1·549125	1·583881	1·634748	1·664246	1·727257
G′	1·527996	1·526208	1·555870	1·592184	1·645268	1·676090	1·742058
H_1	1·532789	1·531415	1·562760	1·600717	1·656229	1·688590	..
$\mu_{D_2} - \mu_C$	·002545	·002670	·003340	·004006	·004934	·005503	·006739
$3·5\,(\mu_{D_2} - \mu_C)$	·0089075	·0093450	·0116900	·0140210	·0172690	·0192605	·0235865
N	58·0540	55·0647	46·2807	40·9395	36·0421	33·7672	30·1115

Lines.	17 L_x	$L_x \backsim L_{D_2}$	$\frac{L_x \backsim L_{D_2}}{L_{D_2} - L_C}$	$\{38 \cdot 2 (L_x \backsim L_{D_2}) + \cdot 12\}^2$
B	2·47446	·0242177	1·391342	1·0923
C	..	·0174060	..	..
E	3·22550	·0199612	1·146800	·7788
F	3·49686	·0359237	2·063869	2·2269
G′	3·91615	·0605876	3·480845	5·9265
H_1	4·28360	·0822026	4·722659	10·6285

Name of Glass.	$(N - 17 L_x)^2$				
	B	E	F	G′	H_1
Hard crown	3089	3006	2976	2931	2891
Soft crown	2766	2687	2659	2616	2579
Extra light flint	1919	1854	1830	1795	1764
Light flint	1480	1422	1402	1370	1344
Dense flint	1127	1077	1059	1032	1008
Extra dense flint	979·2	932·8	916·3	891·1	869·3
Double extra dense flint ..	763·8	722·8	708·3	685·7	667·1

Name of Glass.	$\frac{Y}{10}$	Y			
	B	E	F	G′	H_1
Hard crown	·0000354	·0002591	·0007483	·0020220	·0036764
Soft crown	·0000395	·0002898	·0008375	·0022655	·0041212
Extra light flint ..	·0000569	·0004201	·0012169	·0033017	·0060252
Light flint	·0000738	·0005477	·0015884	·0043259	·0079081
Dense flint	·0000969	·0007231	·0021028	·0057427	·0105441
Extra dense flint ..	·0001115	·0008349	·0024303	·0066508	·0122265
Double extra dense flint	·0001430	·0010775	·0031440	·0086430	·0159324

Name of Glass.	Z				
	B	E	F	G′	H_1
Hard crown	·0035410	·0029186	·0052525	·0088588	·0120192
Soft crown	·0037149	·0030620	·0055105	·0092939	·(126095
Extra light flint ..	·0046471	·0038303	·0068933	·0116260	·0157737
Light flint	·0055737	·0045941	·0082679	·0139443	·0189190
Dense flint	·0068649	·0056583	·0101831	·0171745	·0233016
Extra dense flint ..	·0076566	·0063108	·0113575	·0191551	·0259888
Double extra dense flint	·0093763	·0077283	·0139084	·0234574	·0318260

Errors in Calculated Values.

Name of Glass.	B	E	F	G′	H_1
Hard crown	− *14	− *30	− *28	+ *01	+ *23
Soft crown	− *13	− *85	− *66	− *69	− †104
Extra light flint ..	− *18	− *23	+ *07	+ *80	+ *61
Light flint	− *45	− *72	− *12	+ *99	+ †123
Dense flint	− *61	− *90	− *51	+ *60	+ *28
Extra dense flint ..	− *65	− †111	− *85	+ *90	− *01
Double extra dense flint	− *89	− *51	+ *19	+ †266	

† = ·000 * = ·0000

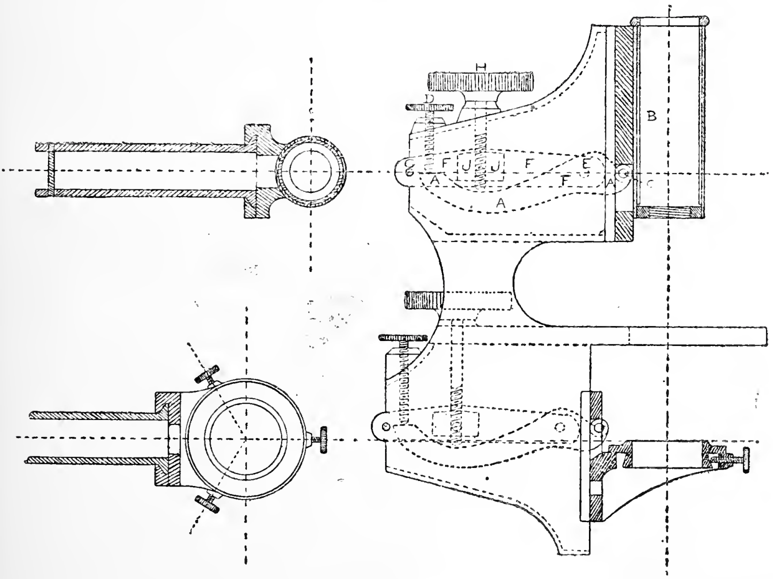
IV.—*A Microscope with New Focussing Mechanism.*

Designed by KEITH LUCAS.

(*Read* 21*st December*, 1898.)

THE instrument of which a representation is given in figs. 27, 28, was constructed primarily with a view to steadiness and rigidity. It was partly for this object that a system of focussing the body-tube and substage was adopted, which effected both coarse and fine adjustments in each case by means of a single planed slide. It will be seen that the consequent reduction of planing is likely to affect also the cost of production of the instrument.

FIG. 27.

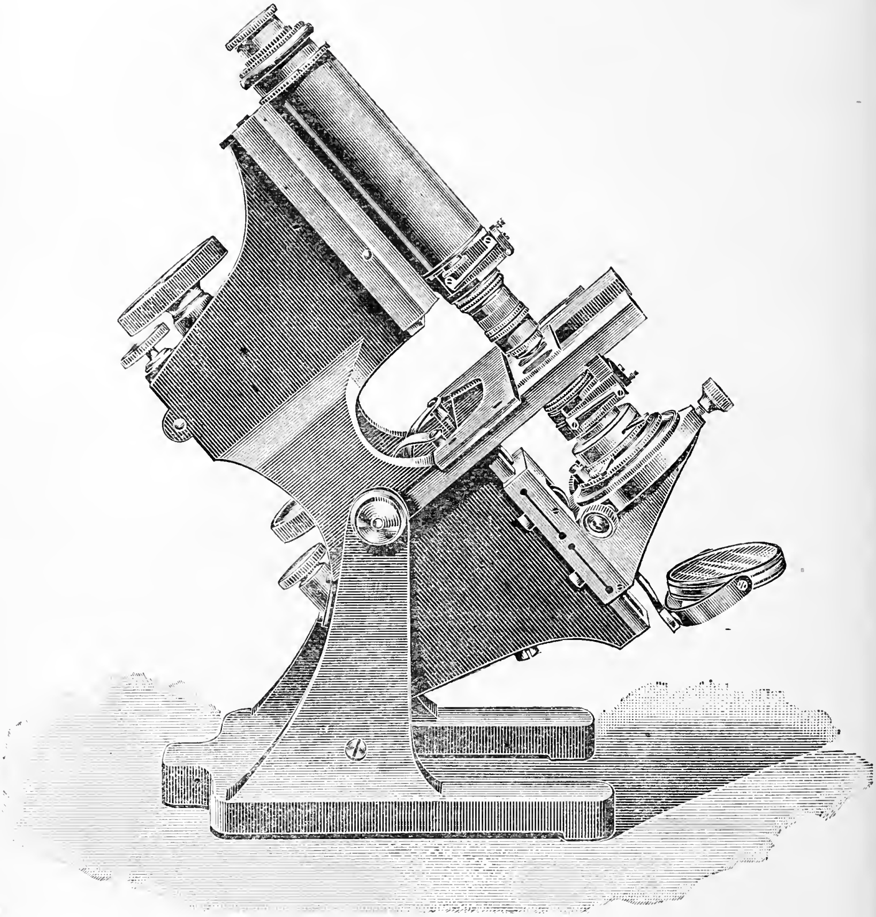


¼ Full Size.

The novelty of the instrument consists essentially in the mechanical arrangement of the coarse adjustments of the body-tube and substage.

The fine adjustment is effected in the way common to many modern instruments. A lever A (fig. 27), contained in the main casting or "limb," engages at one end C with the body-tube B, while the other end is controlled by a micrometer screw D. The fulcrum E is situated comparatively near to the body-tube, the motion of the micrometer screw being thus reduced. The coarse adjustment is effected by raising and lowering the fulcrum of the fine adjustment lever. This is done by a second lever F, whose fulcrum G lies beyond that end of the fine adjustment lever furthest removed from

Fig. 28.



the body-tube. This coarse adjustment lever is controlled by a screw H working into a nut J placed one-third of the lever's length from its fulcrum. In this way the motion of the coarse adjustment screw is imparted in an increased form to the fine adjustment lever. Since then the motions of both coarse and fine adjustment screws are imparted ultimately to the end C of the fine adjustment lever which engages the body-tube, it is evident that the body-tube requires only one planed slide for both adjustments. In order to render the levers more compact, the coarse adjustment lever is made of two separate plates, between which the fine adjustment lever lies. A spring, not shown in the drawing, keeps the body-tube firmly pressed against the end of the lever C.

The milled heads controlling both adjustments lie close together at the back of the instrument, in a convenient position for the hand. To give clearance for the milled head of the substage coarse adjustment, the limb is divided into two parts from the stage upwards for a distance of about two inches. This arrangement is found also to give the stage greater rigidity relatively to the limb.

It is a noteworthy feature of the instrument that all the milled heads controlling the body-tube and substage have their bearings in the main casting; consequently the pressure of the hand on the heads cannot affect the adjustment of focus. This offers an obvious advantage over the ordinary Jackson model with rack-and-pinion; for in the latter the milled heads of the coarse adjustment are almost invariably carried by the fine adjustment slide.

The description of the focussing arrangements of the body-tube applies throughout equally well to those of the substage. The motions are precisely similar, the levers being in fact interchangeable. To ensure rigidity, the limb, stage, and tail-piece are made in one casting.

In the first experimental instrument made, the fulcrum of the fine adjustment lever was raised directly by a screw, without the interposition of a second lever. This arrangement, though perhaps simpler, was abandoned in the instrument shown before the Society, since it was found not to give a sufficiently fast motion to the coarse adjustment. In the instrument shown, five revolutions of the coarse adjustment head, or two hundred and eighty of the fine, move the body-tube through an inch. The range of motion of the coarse adjustment is an inch and a half, that of the fine an eighth of an inch. Since the motion is limited only by the compressibility of the spring used, and not by the levers themselves, a larger range could probably be obtained without difficulty, were it considered necessary. The levers, independently of the spring, would admit of a motion of two inches and a half. The range at present obtained is, however, found sufficient for all work with ordinary objectives.

Other details of the instrument, such as the foot, the stage, and substage, are more or less of ordinary patterns, and call for no special comment.

NOTES.

[Under the head of NOTES, it is intended in future to publish in the *Journal*, at the discretion of the Editor and Publication Committee, any brief and original communications that may be presented to the Society by our Fellows on the Construction of the Microscope, Microscopic Optics, subsidiary Microscopic Apparatus, and kindred subjects.—EDITOR.]

Notes on Colour-Illumination, with Special Reference to the Choice of Suitable Colours.

By Mr. JULIUS RHEINBERG.

(*Read* 15*th February*, 1899.)

"IN the exhibition of objects in multiple colour-illumination before you this evening, I have endeavoured to keep two ends in view. The first was to have as varied a selection of colour-discs as possible; the second, to show as varied a set of objects as possible. The latter seemed to me the more important, and you will find on the tables specimens of physiological and botanical subjects, crystals, fibres, fabrics, insect structures, diatoms, living rotifers, &c., shown by the three different systems.

"The last time I had the honour of bringing colour-illumination before your notice, only two methods were available; but since that time I have come across a third, which, to distinguish it from the high-power or diffraction method and the low-power or refraction method, may be conveniently termed the composition method; it is equally applicable to all powers, and there is no restriction to the cone of light used, as in the first-named methods. It consists of the employment of a disc in the condenser, having preferably a red centre and a green rim, which, when the quantity of green is correctly adjusted by means of the iris-diaphragm to the quantity of red of the central spot, together form white light, so that, without an object in the field, the latter appears practically white. When an object is in the field, though the background is white, the different parts of the object itself do not catch the red and green light in the right proportion to form white light, and the object itself appears coloured, edges and prominent parts coming out in the green colour of the oblique green light thrown upon them, whilst small perforations and other less prominent parts which do not catch the more oblique light to the same extent, appear in red.

"The reason a green disc with red centre is most suitable for this method of illuminating, is because the intensity of coloured rays entering the eye appears to vary with their obliquity. As the red part of the spectrum affects the eye so much more strongly than the other part, the red part of the disc needs to have given to it the special opportunity of affecting the eye in the strongest possible way; therefore the central portion of the disc must be assigned to this colour. *Vice versâ* I have not been able to obtain satisfactory results.

"I may here be permitted to say a few words as to the colours which I have found most suitable for discs for the other kinds of illumination.

"As regards the low-power method, it is essential for good results to keep the central portion of the disc of a colour not too luminous. On this account blue and green are preferable to red, and the most generally useful disc appears to be a malachite-green spot, an "Oxford" blue spot, and an olive-green. If a red ground is used, care must be taken to lessen its brilliancy by narrowing the band of the spectrum which it passes. This can be done by superposing a green; as almost all greens will, curiously enough, be found to transmit a certain range of rays in the red portion of the spectrum. It will be found in general to be a much more convenient way of getting at a good colour for central spots, to superpose different colours, and get at the result by subtraction as it were, than by adding two or three layers of the same colour. For the peripheral portion of those discs in which two colours are employed, red or orange will be found most useful, though almost any colour, no matter whether a pure or a mixed spectrum colour, will do, so long as it is sufficiently luminous relatively to the central spot.

"As regards the choice of discs, it will be found that opaque and thick sections are better seen when a disc is used having both rim and centre coloured; in fact there is a striking difference in the clearness of such objects as seen with a double coloured disc compared with their appearance when discs with centre coloured only are used. On the other hand, the latter kind of disc is usually preferable for diatoms and thin sections.

"Now, with regard to the preparation of discs for use above the objective in the high-power or diffraction method, the colours used for the central spot should not be too dark. It is essential for the most perfect performance of the disc that its central spot should allow a certain range of colours to pass through it common to the peripheral portion. By this means the untoward diffraction effects seen when the dioptric rays are stopped out with a black spot, are evaded and avoided. A light blue or a light green, which, as is well known, usually pass a wide range of the other colours of the spectrum, are to be most recommended for the central spot; a red should only be employed in the centre, when the peripheral portion of the disc is left uncoloured.

"With regard to the choice of discs for viewing particular objects, those with a red periphery, having the centre either coloured light blue or left uncoloured, are most suitable for relatively opaque and thick sections, whilst discs with a blue rim are best where it is a case of wanting to see the finest structure; the reason for this being, of course, that the blue rays diffracted from very fine structure may be just grasped by the objective, whilst the corresponding red ones may be just outside its cone.

"In some previous papers I have mentioned that discs for use above the objective might be made by cementing two cover-glasses together by Canada balsam, filmed surface inwards. Further trials have shown, however, that such discs are inferior in use to single cover-glasses covered with collodion, for anything higher than 1/3 in. objective, because the thickness of the double glass affects the correction of the lens too much, even when fitted with correction collar. With a thin single glass, the corrections are not appreciably disturbed, and can be compensated for entirely by the correction collar and tube-length.

"Reverting now to the employment of colour-discs in the condenser, I should like to show you my latest illuminator (fig. 29). You will observe it consists of a box, open at the ends, fitted under the condenser, in which there are a number of metal carriers, which can be pulled out or pushed in quite independently of one another by means of little handles. So that they may slide freely, each carrier is separated from the next by a sheet of celluloid. Each carrier has two circular apertures, the one being fitted with a colour-disc or other stop, the other one being left free. The kind of stop is indicated on the handle. The openings in the carriers are so arranged that when the apparatus is closed all the free openings coincide, so that illumination can be effected in the ordinary way. When any other illumination is required, it is only necessary to pull out the particular stop or combination of stops, each stop being in accurate position when pulled out as far as it will go. The special thing about the particular illuminator I have here, is that the edges of the carriers are turned over, so that the gelatin or other stop can be slid into them freely, and therefore easily centered.

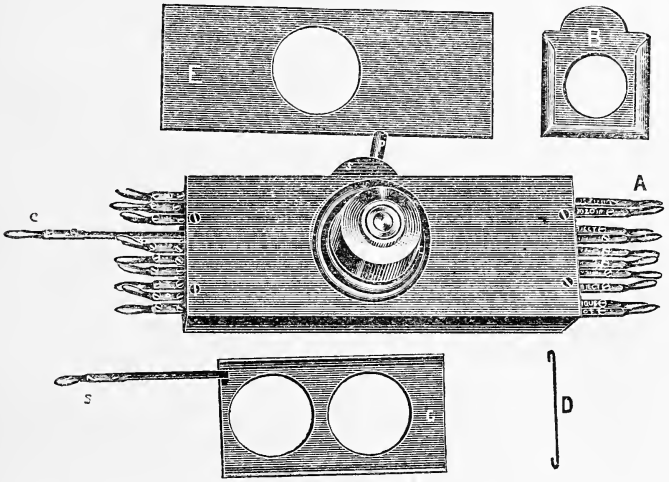
"Though the illuminator is bulky in the hand, it packs away under the stage of the Microscope, so as to be out of the way, and in use it is very convenient for rapidly comparing the effects of different stops.

"A good *large* source of light is the best when low-power or the composition method of illumination is resorted to. This may be obtained by using the bull's-eye in the usual way, or by placing a piece of ground glass immediately in front of the luminant, and dispensing with the bull's-eye. Personally I always use a Welsbach light, with a piece of ground glass just in front. In this way the source of light, besides having considerable extent, is a truly plane surface, and this I think is a great advantage over any source of light of irregular shape such as a lamp flame. Indeed, if I may say so, I believe insufficient attention has been given to using a plane surface of light in general microscopic work; which is curious enough, considering the attention given to the aplanatism of condensers. Surely the one demands the other.

"I have, in conclusion, only to add that we are indebted to Messrs. W. Watson and Sons and R. and J. Beck, Ltd., for the loan of the Microscopes displayed this evening, whilst a number of the slides are from the collection of the Society.

"To most of the cards at the sides of the Microscopes, a colour-disc is attached, exactly the same as the one employed in the instrument; and by holding the cards against the light, the colours can be examined."

Fig. 29.



A, Colour illuminator, with Abbe 1·4 N.A. condenser, seen from top, showing one carrier, *c*, pulled out; *p*, pointer of iris diaphragm; *s*, projecting part of a special carrier B, which can be pulled out altogether, and any kind of stop inserted as required.
C, One of the metal carriers, top view; *s*, screws for affixing little metal plate or coloured piece of gelatin, indicating kind of stop.
D, Cross section of metal carrier.
E, One of the sheets of celluloid separating the carriers.

Stops on left-hand side.

1. Matt ground celluloid spot.
2. Black central spot.
3. Blue " "
4. Red " "
5. Green " "
6. Red spot, green periphery (composition method illumination).
7. Large red spot, green periphery, (composition method illumination).
8. Black and white quarters.
9. Clear annulus in black stop.
10. Malachite green screen.

Stops on right-hand side.

1. Black annulus, 5–15 mm. diameter.
2. " " 10–20 mm. "
3. Blue periphery, clear centre.
4. Red " " "
5. Green " " "
6. Yellow " " "
7. Red and green halves, clear centre.
8. Blue and red quarters " "
9. Adjustable oblique light stop.
10. Adjustable slot.

N.B.—For low-power colour illumination the top lens of condenser must be removed.

TABLE OF COMPARISON OF THE THREE METHODS OF COLOUR-ILLUMINATION.

Method.	Colour-differentiation dependent	Available with	Chiefly suitable for	Cone of light from condenser used.	Colour-disc placed	Cone of light transmitted by central differentially coloured part of the colour-disc.
1st, referred to as high-power or diffraction method.	Chiefly on diffraction.	All powers.	Medium and high powers.	Narrow compared to objective cone.	Above or between lenses of objective.	Narrow compared to objective cone.
2nd, referred to as low-power or refraction method.	Chiefly on refraction and reflection.	Low powers.	Low powers.	Much wider than objective cone.	In sub-stage condenser.	Equal or slightly exceeding objective cone.
3rd, referred to as composition method.	Chiefly on position and form of the different parts of the object, without diffraction playing any determining part. In exceptional cases, however, wholly due to diffraction.	All powers.	Medium and high powers.	Any cone at will, greater than that passed by central spot of colour-disc, and not exceeding objective cone.	In sub-stage condenser.	According to circumstances; any cone less than objective cone.

A list of the objects exhibited under multiple-coloured illumination will be found on p. 245.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Experiments on Heredity.‡—Prof. J. C. Ewart has collected his previous papers describing his "Penycuik experiments," some of which have been already reported in this Journal, and has prefaced them with a general essay, in part introductory and in part supplementary. The book is beautifully illustrated with photograms. The chief results may be summed up as follows.

(1) By numerous experiments in hybridising, Prof. Ewart has placed the doctrine of reversion on a firmer basis than it has hitherto had. Thus a pure white fantail cock-pigeon, which in colour proved to be prepotent over a blue pouter, was mated with a cross previously made between an owl and an archangel, and the result was a couple of fantail-owl-archangel crosses, one resembling the Shetland rock-pigeon, and the other the blue rock of India. And again, a smooth-coated white rabbit, derived from an Angora and a smooth-coated white buck, was mated with a smooth-coated, almost white doe (grand-daughter of a Himalaya doe); and the result was that in the litter of three, one is the image of the mother, one is an Angora, like the paternal grandmother, and one is a Himalaya, like the maternal great-grandmother.

(2) Some interesting facts are given in regard to the origin of "prepotency" as a result of inbreeding, and the important suggestion is made that prepotency may be an important evolution-factor, accounting for the persistence of variations in their early stages.

(3) The two aspects of inbreeding are very clearly illustrated: on

* 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, &c., 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 and Reproduction, and allied subjects.

‡ 'The Penycuik Experiments,' by J. C. Ewart. London, 1899, 8vo, xciii. and 177 pp., 46 figs.

the one hand, it is advantageous in fixing character and developing prepotency; on the other hand, there is a necessary lessening of the possible range of variability, and a risk of degeneration if a taint occur, or the obscure limits of stability be exceeded.

(4) A number of experiments have been made likely to give telegony the best possible chance of declaring itself; and although Prof. Ewart abstains from dogmatic conclusions, and suggests a whole series of experiments which should be made, the verdict is clear that so far the case for telegony is non-proven. Though we have given the merest outline of the results, we have said enough to show that this interesting volume is a timely and important contribution to the study of heredity and kindred problems.

Functions of the Thymus.*—Dr. J. Beard begins a very interesting paper on "the true function of the thymus," by noting that there is hardly an organ in the body about whose function in the embryo and at later periods so little is really established.

Since Kölliker discovered its mode of origin in mammals from the epithelium of a gill-pouch, and stated that the original epithelial cells give rise to lymph-cells or leucocytes, two positions have been held in regard to the thymus. Some, like Stieda and His, have maintained that the leucocytes so characteristic of the thymus have migrated thither from the exterior, possibly from the mesoblast. Others, like Kölliker himself, maintain that the original epithelial cells of the thymus give rise to lymph-cells or leucocytes.

Dr. Beard has studied the question for many years in *Raia batis*, the smooth skate, but has only now reached conclusive results. At the period when leucocytes first appear, there is no spleen, nor rectal gland, nor lymphoid structures of any kind, but the primordia of the thymus are present, and it is from their epithelial cells that the first leucocytes are formed. When the thymus elements set to work in earnest to form leucocytes, i.e. in embryos of 28 mm. and upwards, these wandering cells, true to their "hereditary instincts," begin to emerge in crowds, causing larger or smaller "breaks" on the contour of the thymus.

It is Kölliker's great service to have shown that leucocytes arise in the thymus from its original epithelial cells; to Gulland's researches we owe the result that the first leucocytes are found in the mesoblast in the neighbourhood of the thymus; and Dr. Beard has now shown that the first leucocytes arise in the thymus from its epithelial cells, and that thus it is the parent source of the leucocytes of the body.

Experimental Embryology.†—Prof. O. Hertwig has made experiments on the influence of centrifugal force on the developing ova of the frog. When this is exerted in a certain degree (experimentally determined) on the eggs of *Rana esculenta*, it produces a more marked separation of the lighter and the heavier substances, in consequence of which the cleavage process is restricted to the "animal half" of the ovum. In the course of segmentation the ovum assumes a character quite divergent from the normal, and in fact very closely approximating to the meroblastic type. An undivided yolk-containing portion occupies

* Lancet, Jan. 21, 1899, 11 pp.
† Arch. Mikr. Anat., liii. (1898) pp. 415–44 (2 pls.).

from one-half to two-thirds of the whole egg; the remainder is formed by a blastoderm with a blastocœl; and the resemblance is heightened by the formation of a special layer of merocytes—a yolk-syncytium—beneath the blastoderm. Yet, if removed in due time from the abnormal influence, these eggs may give rise to segmented embryos with the normal complement of organs. Similar experiments were also made with the eggs of *Rana fusca*. The paper closes with a discussion of the conception of "formative forces."

Post-Embryonic Development of Striped Muscle.*—Prof. B. Morpurgo has studied this in white rats. In the first period of extra-uterine life, the fibres of the skeletal muscles increase in number, and the process is introduced by a mitotic nuclear division in less differentiated elements. Thereafter no increase in the number of fibres occurs, but the nuclei multiply by amitosis as the muscles elongate. The subsequent thickening is solely due to increase of the contractile substance,—a process dependent on nutritive and functional conditions rather than on inheritance.

Orthogenetic Variation in Chelonia.†—Dr. H. Gadow has investigated 20 newly-hatched specimens of the "loggerhead" turtle, *Thalassochelys caretta*, collected from one nest by Dr. Willey, supplementing this material by 21 newly-hatched and 15 other specimens of all sizes. The variations are very numerous and manifold. The number of median scutes varies between 8 and 6, and the lateral or costal scutes range between 7 and 5, and they are either symmetrical or uneven, there being perhaps 7 on the left and 6 on the right side, or *vice versâ*. The normal shield possesses 6 median (including the so-called nuchal), and 5 pairs of costal scutes. Of the total of 56 specimens, not less than 43 are abnormal, = 76·6 per cent.; of the 41 newly-hatched, not less than 38 are abnormal, = 92·7 per cent. The percentage of abnormalities is four to five times as great in the newly-hatched as in the adult, and it decreases gradually from the smaller to the larger and very large specimens. The abnormalities are "atavistic reminiscences," from which most of the individuals rid themselves, and the reduction or squeezing-out of some of the scutes proceeds in a very regular way. "Since the variations all lie in the direct line of descent (and the more serious the variation, the further back it points)," the author calls this kind of variation orthogenetic.

Division-Processes in Primordial Ova of an Adult.‡—Dr. W. Stoeckel describes a case in which a normal ovary in a woman showed in many of the primordial ova two nuclei, and in some cases three or even four. He maintains that this instance, which does not stand alone, makes it necessary to abandon the usual statement that there is no multiplication of ova or follicles after uterine life. Abundant division seemed to be going on in this adult of 29 years of age.

Nutritive Cells in Spermatogenesis.§—Dr. K. Peter discusses the phenomena of spermatogenesis in representative types, and comes to the

* Anat. Anzeig., xv. (1898) pp. 200–6.
† Proc. Cambridge Phil. Soc., x. (1899) pp. 35–7.
‡ Arch. Mikr. Anat., liii. (1898) pp. 357–84 (1 pl.).
§ Tom. cit., pp. 180–211 (1 pl.).

conclusion that in the higher animals the spermatozoa are incapable of nourishing themselves, or of differentiating without assistance. In various degrees there has come about a profitable division of labour in the testis between the reproductive cells proper and the nutritive cells. This specialisation is very variously expressed, as the author indicates in detail. All the various elements known as cyst-cells, follicle-cells, basal-cells, &c., are physiologically equivalent; they are the nutritive cells of the maturing spermatozoa.

Effects of Castrating Cocks and Hens.*—Herr H. Sellheim has made a number of interesting experiments. The castration of young cocks has a very diverse effect on the secondary sex-characters, sometimes decreasing them, sometimes increasing them. The capons seldom crow, or do so abnormally; moulting is normal; attempts at copulation are rare. But one general result seems to be established:—that the whole body is affected; the larynx is intermediate in size between that of cock and hen; the syrinx is weakly developed; fat accumulates in the subcutaneous and subserous connective tissue; the brain and heart are light in weight; the skeleton shows many abnormalities. The experimenter describes the thorough castration of the hen as almost impossible, and changes in the secondary sex-characters were little marked.

Passage of Toxins from Fœtus to Mother.†—A. Charrin has made a number of experiments to test this possibility. Soluble bacterial products (of Löffler's bacillus, &c.) were introduced into unborn rabbits in eight cases, in five of which there was evidence that the toxin traversed the placenta and affected the mother; in two cases peritonitis resulted; and in one case the rabbit survived unaffected. In a second set of experiments, he used pyocyanic toxin in eleven cases, and three seemed to show that the resisting power of a pregnant female towards a particular microbe may be increased through the fœtus. It does not seem, however, that the experiments were sufficiently numerous or conclusive to warrant any general statement.

Intercellular Bridges in Development of Amphioxus.‡—Herr H. Klaatsch describes a well-developed system of intercellular connections in the early stages of *Amphioxus*. They persist until the end of the gastrulation at least. It is further noted that, while ectoderm cells are thus linked together, and endoderm cells likewise, there is no connection between the elements of the two layers except at the transition-area where they meet.

Embryos of Chlamydoselachus.§—T. Nishikawa makes some confessedly fragmentary notes on the embryos of the rare Japanese shark *Chlamydoselachus anguineus* Garm. The animal is viviparous, and breeds in spring. The left oviduct is somewhat rudimentary; the nidamental gland of the right side is more developed than that on the left; the right oviduct is greatly distended with the eggs (3–12). Various stages of embryos are described, but we fail to find anything noteworthy.

* Beitr. Geburts. u. Gynäk., i. (1898) pp. 229–46. See Zool. Centralbl., vi. (1899) pp. 38–9.
† Comptes Rendus, cxxvii. (1898) pp. 332–5.
‡ SB. Akad. Wiss. Berlin, 1898, pp. 800–6 (4 figs.).
§ Annot. Zool. Japon., ii. (1898) pp. 95-102 (1 pl. and 3 figs.).

Endocardiac Epithelium of the Salmon.*—Dr. B. Nöldeke is unable to find any evidence that the endothelium of the heart is of purely mesodermic origin. On the contrary, it is not possible to define the limits of endoderm and mesoderm in the primordium (*Anlage*) of the heart. The endoderm certainly has at least a share in forming the endocardiac epithelium.

Theory of Growth and Fertilisation.†—Herr Z. Bernstein starts from the idea of an "*Urmaterie*," in which growth and reproduction coincide. The vicissitudes of environmental conditions induce variability; the struggle for existence begins, and the action of inhibitive forces becomes more marked. Sexual reproduction, arising in the originally fortuitous fusion of diverse plasma-individuals, implies a lessening or assuaging of the aforesaid inhibitive forces, so that the growth-tendency has again its opportunity. The sex-elements are characteristically different in nature; indeed, the whole point is in their difference. We have not, however, seen the original paper.

Hairs of Monotremes.‡—Prof. Baldwin Spencer and Miss G. Sweet find that the early development of the hair-follicle in monotremes is in the form of a solid epidermic downgrowth, not tubular as Poulton supposed. Their net result, in fact, is that the development of the hairs in monotremes is in all essential respects the same as that in other mammals.

Bone-Structure and Inheritance.§—Dr. R. Schmidt discusses the minute architecture of the bones, especially at the joints, and comes to the conclusion that in the course of function adaptive characteristics are acquired whose transmissibility is equally well shown, both by the history of the race and by the course of individual development.

b. Histology.

Ciliary Movement.‖—Dr. K. Peter has made numerous experiments on the long ciliated cells from the lining of the gut of the freshwater mussel, in order to come to some decision in regard to the "centre" for the ciliary movement. The most important results are the following.

(1) Non-nucleated portions of ciliated cells move actively, therefore the nucleus is not essential to the play of cilia.

(2) Isolated cilia without cytoplasm also continue their movements, therefore the cytoplasm is not essential.

(3) The kinetic centre must be in the ciliary structure itself, and since those with much damaged basal cones still function, while torn-off cilia do not work, the motor centre must be in the "basal corpuscle."

Secretory Phenomena in Poison-Gland of Adder.¶—Herr W. Lindemann has studied the influence of subcutaneous injections of atropin and pilocarpin. The former stops the secretion, the latter increases it. The appearance of the homologous glands in the grass snake was not changed

* Zeitschr. wiss. Zool., lxv. (1899) pp. 517–28 (1 pl.).
† Arch. Entwickmech., vii. (1898) pp. 511–21.
‡ Quart. Journ. Micr. Sci., xli. (1899) pp. 549–88 (3 pls., 6 figs.).
§ Zeitschr. wiss. Zool., lxv. (1898) pp. 65–111 (2 pls.).
‖ Anat. Anzeig., xv. (1899) pp. 271–83 (4 figs.).
¶ Arch. Mikr. Anat., liii. (1898) pp. 313–21 (1 pl.).

by either injection. It seems that the poison-gland has continuous secretion like the liver, and that the details of the process are quite analogous to those in ordinary salivary glands. Homogeneous drops appear in the cytoplasm, which then becomes clearer; when the drops are expelled, the peripheral parts of the cells become darker.

Red Blood-Corpuscles of Lamprey.*—Dr. M. C. Dekhuyzen finds that these are goblet-like or bell-like. The cell shows a fairly deep concavity,—the "orale Delle," and there is also a less distinct "aborale Delle." Thus the "bell" may at times appear as a thick biconcave disc, as was pointed out by R. Wagner in 1838, and by Gage in 1888. In rat, guinea-pig, rabbit, &c., the red blood-corpuscles pass through a similar phase, for which the author proposes the term "Chromokrateren." He has found the same shape in the Pycnogonid *Phoxichilidium femoratum*, and he believes that it occurs in some worm-types. Indeed he regards the goblet-like shape as ancestral.

Skin-Glands of Toad.†—Dr. O. Weiss has studied the poison-glands in *Bufo cinereus*. The glandular epithelium is seated on a fine membrana propria; then follows a layer of smooth muscle-fibres; then the loose connective tissue of the cutis which surrounds the whole gland. By keeping the animals in cold surroundings, he was able to retard the mode of secretion, and thus study it in greater detail. The whole process is described. Besides the poison-glands there are mucus-glands, and the two kinds are quite distinct.

Origin of Myelin.‡—Herr R. Wlassak finds that myelin is demonstrable in the protoplasm of the spongioblasts in the central nervous system of the embryo even before blood-vessels have penetrated. Yet his general result is that the myelin is not formed in the nerve-fibre itself, but is of exogenous origin. The true source is in the blood, whence the myelin passes to the nerve-fibres through the cells of the supporting tissue, which has thus a chemical as well as a mechanical function.

c. General.

Nature of Life.§—Dr. G. Mann believes that what constitutes life is the presence of a number of "organic" compounds, capable of mutually reacting on one another, and thus giving rise to new compounds which, because of their origin, have no further chemical interaction, and therefore form a comparatively stable mantle round the unstable or active groups which gave rise to them. The cytoplasm has the following functions:—It elaborates food substances so as to make them directly assimilable by the nucleus; it protects the nucleus from deleterious influences; and it either attracts food to the cell or moves the cell towards the food. The mantle or envelope of cytoplasm forms a new environment which has been created between the chemically active groups and the world at large.

* Anat. Anzeig., xv. (1898) pp. 206–12 (6 figs.).
† Arch. Mikr. Anat., liii. (1898) pp. 385–96 (3 figs.).
‡ Arch. Entwickmech., vi. (1898) pp. 453–93 (4 pls.). See Zool. Centralbl., v. (1898) pp. 875–6.
§ Trans. Oxford Univ. Junior Sci. Club, N.S., No. 6, 1899, pp. 99–101.

Food of Marine Fishes.*—Dr. G. B. De Toni has a useful little paper in which he brings together numerous facts and references as to the food of marine fishes.

Winter-Plankton in Large and Small Basins.†—Dr. O. Zacharias raises a very interesting problem by stating in his usual careful manner the differences which obtain as to the same species in the winter-plankton of large and small water-basins. In the small basins there is a remarkable persistence in numerical strength which is not exhibited in the large. He shows that it is not a matter of temperature, and he emphasises in passing that in fresh-water plankton light is more important. Thus the high productivity in April, as compared with March and February, is mainly referable to the increasing intensity of the illumination. But how is it that, in spite of the meagre sunshine of November and December, there is an almost luxuriant ("*fast üppig*") productivity in the planktonic diatoms in small basins? And on the vegetable plankton the animal plankton of course depends. His theory is that many algæ are capable of "amphitrophy," in other more intelligible words, that they are able to feed upon the dissolved organic substances in the water, which are naturally more available in the limited area of a small basin.

Fauna of Wadi Natroun.‡—Herr J. Dewitz gives an interesting account of what he observed during a stay of two months in this valley of soda-lakes which lies in the Libyan desert about 170 kilometres from Cairo. Grasshoppers, cicadas, bugs, beetles, *Planorbis*-like shells, *Helix desertorum*, &c. are recorded; but it is perhaps of most interest to notice his remarks on the red waters of the soda-lakes themselves. The redness seems to be due to bacteria, but at certain seasons *Artemia salina* is abundantly present. From resident birds and a desert fox he obtained various parasitic worms, which probably have arthropods as their intermediate hosts, since there are no fishes and only two species of molluscs.

Tunicata.

The Ascidian Half-Embryo.§—Mr. H. E. Crampton, jun., finds that an isolated blastomere of *Molgula manhattensis* segments in a strictly partial fashion as if it were still a part of an intact embryo. The result is a larva of less than normal size, and with certain defects. Later on, however, a process of regeneration gradually masks the partial nature of the development, and the final result is nearly complete.

INVERTEBRATA.

Mollusca.

γ. Gastropoda.

Dimorphism in Crepidula.‖—Prof. E. G. Conklin gives examples of "environmental polymorphism" (a useful phrase) in *C. convexa* and

* La Nuova Notarisia, x. (1899) pp. 21–7.
† Zool. Anzeig., xxii. (1899) pp. 25–31. ‡ Tom. cit, pp. 53–61.
§ Ann. New York Acad. Sci., x. (1898) pp. 50–7 (2 pls.).
‖ Proc. Acad. Nat. Sci. Philadelphia, 1898, pp. 435–44 (3 pls.). See Amer. Nat. xxxiii. (1899) pp. 160–1.

other species. Upon the shells of *Illyonassa* or *Littorina* the specimens are deeply convex and darkly pigmented; on oyster shells they are much flatter and lighter. Dimorphism in *C. plana* is exhibited by the occurrence of a dwarf form in addition to the normal one. This is a "physiological variety" (a less fortunate phrase) in which the shape and size of the body, as well as the number of cells in the entire organism, are modified by the direct action of the environment. There is no evidence that these modifications are heritable. The dwarfs are not a race, but are constantly recruited from the young of the giants.

Sexual dimorphism is also well marked in *C. plana*, the average female being about fifteen times as large as the average male. The smaller size is due to the smaller number of cells in the body. The size of the cells is the same. Whatever the ultimate cause of the smaller size of the male, it operates, as in the dwarf, by causing a cessation of cell growth and division.

Variations in the Shell of Helix nemoralis.*—Mr. J. L. Howe has made large collections of this snail at Lexington, Va., where the colony seems to have been started in 1883 by imports from Europe. His aim was to get light on the following questions:—(*a*) Does the tendency to variation proceed along certain definite lines? (*b*) Does this tendency vary in different localities? and (*c*) Will a very considerable destruction of individuals materially modify the tendency? His study seems to give an affirmative answer to (*a*) and (*b*), and a negative answer to (*c*). The colony gives at any rate an interesting example of the results of a tendency to variation in a favourable environment, for the snail seems to have almost no enemies.

Habits of Eolis papillosa.†—M. Louis Boutan has made some very interesting experiments with this nudibranch which feeds on anemones in spite of all their stings. Hecht has maintained that the Eolids which have stinging cells themselves are immune to those of hydroids and sea-anemones, and has pointed out the interesting fact that the only species without nematocysts, *Calina glaucoides*, feeds on embryos of fishes. But the experiments made by Boutan show that the immunity is far from absolute; for a specimen weakened by reproduction was unable to tackle a vigorous *Anthea cereus*, and was engulfed by it. He seeks for the source of the relative immunity in the secretion of mucus, which is markedly lessened at the reproductive period.

Functions of the Radula.‡—Prof. H. A. Pilsbry makes a note on the great length of the radula of *Nerita peloronta* compared with that of the animal, and the large number of similar teeth at the margins. Specialisation in the Rhipidoglossa and Pulmonata has proceeded from the median line of the radula outward, the outer teeth being the last to be modified, and therefore of value as indicating the ancestral condition. This mode of change is probably the result of the greater functional activity of the median portion in feeding, due to the rounded shape of the subradular cartilage.

* Amer. Nat., xxxii. (1898) pp. 913–23.
† Arch. Zool. Expér., vi. (1898) Notes et Revue, pp. xxxvii.–xlii.
‡ Proc. Acad. Nat. Sci. Philadelphia, 1898, p. 202.

Arthropoda.

α. Insecta.

Parthenogenesis in Lepidoptera.*—Prof. M. Nussbaum gives an interesting historical account of what has been previously observed in this connection, and a summary of his own experiments on *Bombyx mori*, *Porthesia chrysorhœa*, and *Liparis dispar*. It was only with the first named, however, that he succeeded in demonstrating parthenogenetic development. Out of 1102 unfertilised ova of the silk-moth, 22 developed up to a certain point; while out of 1260 fertilised eggs, 1190 developed—a contrast of 2 per cent. and 94·5 per cent. The unfertilised ova showed segmentation and a slight blastoderm, but never hatched; while 70–91 per cent. of the fertilised eggs hatched successfully. In most cases unfertilised and fertilised eggs were observed from the same mother, and the two sets were kept as far as possible in the same conditions, so that the decisive factor is clearly the occurrence or non-occurrence of fertilisation.

Castrated Caterpillars.†—Herr J. Th. Oudemans has succeeded in the difficult operation of castrating caterpillars, and finds that the process has little result either on the external appearance or on the habits of the adults.

Mosquitoes and Malaria.‡—SS. B. Grassi, A. Bignami, and G. Bastianelli come at present to the following conclusions.

The Hæmosporidia or Hæmamœbinæ of malaria pass in a man through a chapter of their life-cycle characterised by the long duration of the amœboid phase and the absence of encapsuled stages. How many times they may reproduce is undetermined; but they also give rise to forms which remain sterile in man. The last reach the intestine of the adult *Anopheles claviger* Fabr., and develop as typical Sporozoa, forming an enormous number of sporozoites, which accumulate in the salivary glands, and return to man in the process of puncturing. It is claimed as demonstrated that the parasites pass directly from man to mosquito, and from mosquito to man; but other species of Diptera besides *Anopheles claviger* may also share in the dissemination, and the question of passage from the parent insect to its offspring is left open.

Development of Head of Hymenoptera.§—L. G. Seurat describes the formation of the imaginal head in a Braconid, *Doryctes gallicus*, a point in regard to which there has been much controversy. The general verdict hitherto has been that the head of the imago is formed from the head and the first segment of the body of the larva. Seurat's observations show that the head is wholly formed from the head of the larva. It is at first invaginate, but by a rotation in the median plane it is evaginated, and assumes its final form.

Wings of Insects.‖—Messrs. J. H. Comstock and J. G. Needham now discuss the venation of Odonata in illustration of the specialisation

* Arch. Mikr. Anat., liii. (1898) pp. 444–80.
† Zool. Jahrb., xii. (1898) pp. 71–88 (3 pls., 2 figs.).
‡ Atti R. Accad. Lincei (Rend.), viii. (1899) pp. 21–8. Cf. this Journal, *ante*, p. 32.
§ Comptes Rendus, cxxviii. (1899) pp. 55–6.
‖ Amer. Nat., xxxii. (1898) pp. 903–11 (figs. 60–68). Cf. this Journal, *ante*, p. 31.

of wings by addition. The tendency throughout the order is towards vein multiplication. Additions are made upon both sides of several principal branches, and they conform to no one simple type. These new branches are preceded by tracheæ; but there are other interpolated veins developed for mechanical advantage quite independently of the tracheæ, and cutting across them.

"All the peculiarities of the intricate venation have arisen out of the necessity for making all the veins individually useful; and those dragon flies which have been most successful in differentiating between the added veins are among the fleetest of winged creatures."

A further instalment * deals with the wings of Ephemerids, which seem, at first sight, very different from those of any other order. A marked "cephalisation" of the flight-function has taken place, and a reduction of the hind wings, sometimes (*Cænis et al.*) to nil. In a few genera (*Oligoneura et al.*) both pairs of wings are furnished with but few veins, yet these are degraded and not generalised. Apart from the "cephalisation" of the flight-function, the corrugating of the wings has been the chief line of specialisation in this order.

Digestion in the Meal-Worm.†—Herr W. Biedermann finds that the cells of the mid-gut epithelium of the larva of *Tenebrio molitor* show, in cytoplasm and nucleus, accumulations of reserve-material in the form of protein-granules and protein-masses (*Klümpchen*). With abundant nutrition the former are very abundant, but there are few of the latter; in starved larvæ the masses are more abundant than the larger grains.

The mid-gut is never empty. It contains a lamellated cylinder with plate-like crystalloids between the lamellæ. This appears to be formed by a wholesale expulsion of epithelial cells into the lumen of the gut. As to digestive ferments, the following were demonstrated:—an amylotic and inverting ferment; a trypsin-like ferment affecting proteids; and a fat-splitting ferment. There is also another which brings about an oxidation of the tyrosin.

Parasites of Caterpillars.‡—M. Arnold Pictet finds reason to believe that caterpillars attacked by parasitic Hymenoptera and Diptera form their cocoon at a date much earlier than those in health, a result which seems rather to the advantage of the parasite.

Chromatin Reduction in Hemiptera.§—Dr. T. H. Montgomery, jun., corrects his previous statement that the second spermatocytic reduction division in the genus *Euchistus* is a transverse division of the chromosomes, like the first. Further study leads him to agree with F. C. Paulmier that the second reduction division is normally a longitudinal (equatorial) division. At the same time, it may be, as a variation, transverse instead of longitudinal, which is "especially interesting as being a point in corroboration of the conclusion of O. Hertwig, in opposition to Weismann, that in reduction it is the halving of the chromatin mass, and not the plane of division, which is the important result." In

* Op. cit., xxxiii. (1899) pp. 117–26 (figs. 69–73).

† Pflüger's Arch. ges. Physiol., lxxii. (1898) pp. 105–62. See Zool. Centralbl., vi. (1899) pp. 65–7.

‡ CR. Soc. Phys. Hist. Nat. Genève, in Arch. Sci. Phys. Nat., vii. (1899) pp. 79–80.

§ Zool. Anzeig., xxii. (1899) pp. 76–7. Cf. this Journal, 1898, p. 73.

the same cell some of the chromosomes may be split longitudinally, some transversely.

Anal Glands of Brachininæ.*—Dr. L. Bordas shows how the structure of these organs is adapted to expel the fluid which these little beetles (*Brachinus explodens*, &c.) use for defensive purposes. He also points out that the presence of a chitinous intima, lining the internal cavities of the receptacle and of the terminal excretory duct, proves the origin of these two parts from integumentary invaginations.

γ. Myriopoda.

Histogenesis of Poison-gland in Scolopendra.†—O. Duboscq has an interesting note on this point, in regard to which he shows that the poison is formed in the nuclei of the secretory cells at the expense of the chromatin. He points out that this is in harmony with the fact that certain active substances in poisons are nucleo-albumins.

δ. Arachnida.

Habits, History, and Species of Pœcilotheria.‡—Mr. R. I. Pocock discusses this genus, representative of that great and almost cosmopolitan group of spiders which was formerly included under the comprehensive title *Mygale*—a term which is still to be found in many recent text-books of zoology. They may kill small or young birds, but there is no warrant for the widespread and sensational belief that these form the spider's staple article of food, for they feed almost entirely upon insects. Some of these large spiders live in burrows lined with silk, or beneath stones, but the species of *Pœcilotheria* are arboreal. The colouring is very varied, and while that of the upper surface is apparently protective, that of the under surface, which is startlingly different, has probably a warning significance. Eight species are described from Ceylon and Southern India; of these four are new.

Tick-Fever in Cattle.§—Mr. C. J. Pound claims to have worked out protective inoculation for tick-fever. "Up to the present time some thousands of head of cattle have been inoculated, and the results have proved highly satisfactory; for when such cattle are subjected to gross tick infection, or injected with virulent blood, they remain perfectly immune, while the "controls," or unprotected animals, subjected to the same conditions, are readily attacked with severe and acute fever, which often ends fatally. So successful have our experiments been that numbers of stock-owners, whose cattle are threatened with an invasion of tick, have lost no time in systematically inoculating the whole of their herds." We should have liked, however, if Mr. Pound had given a summary of the statistical results of his experiments.

Mites of Mummification.‖—P. Mégnin has studied a somewhat ghastly subject, the corpse of a murdered person that lay eighteen

* Zool. Anzeig., xxii. (1899) pp. 73–6 (2 figs.).
† Arch. Zool. Expér., vii. (1898) Notes et Revue, pp. xlix.–li.
‡ Ann. Nat. Hist., iii. (1899) pp. 82–96 (1 pl.).
§ Journ. Quekett Micr. Club, vii. (1898) pp. 118–9.
‖ Arch. Parasitol., i. (1898) pp. 39–43. See Zool. Centralbl., v. (1898) pp. 830–1.

months under straw in a cave. Under the hard brown skin there were neither muscles nor blood-vessels to be seen, only a fibrous dry mass of connective tissue fibrils and débris of muscle-fibres, with countless mites. He reports the occurrence of *Tyroglyphus siro*, *T. longior*, *Coprophagus echinopus*, *Uropoda nummularia* sp. n., and *Cheyletus eruditus*, which, with the exception of the last, had effected the mummification of the corpse. In another case this was due to *Tyroglyphus infestans*.

ε. Crustacea.

Alimentary Canal of Oniscidæ and Asellidæ.*—Herr W. Schönichen describes the four regions,—œsophagus, gizzard, mid-gut, and rectum. For the first time, a clear and full description of the gizzard is given, and the syncytial nature of the mid-gut epithelium is conclusively proved. Pores on the intima of the mid-gut are also noted, and evidence is given that this area is at once absorptive and secretory. The author has discovered two peculiar canals diverging from the gizzard, but has no clue as to their meaning. The gizzard has no pores on its intima, and is certainly neither secretory nor absorptive. Some interesting notes on the moulting of the gut are also communicated.

"Mid-Gut" of Isopods.†—Dr. J. Playfair McMurrich points out very forcibly that Schönichen has quite misunderstood his position in regard to the function of the mid-gut in Isopods. In his paper,‡ McMurrich, while maintaining the ectodermic origin of the "mid-gut," stated quite distinctly that "digestion and absorption are both performed by the liver cæca, and apparently by them alone."

British Pandalidæ.§—Mr. W. T. Calman gives descriptions of the four species of *Pandalus* now known to occur in British waters, viz. *P. montagui*, *P. brevirostris*, *P. propinquus*, and *P. leptorhynchus*, noting several characters not hitherto pointed out. The very aberrant branchial formula of *P. brevirostris* may perhaps be held to justify the recognition of a new genus, for which the name *Pandalina* is proposed.

New Cirripedia.‖—Dr. C. W. S. Aurivillius gives a preliminary notice of the collection of Cirripedia formed on the Prince of Monaco's expeditions. There are 43 Lepadidæ and Balanidæ, of which about half are new. Some of the new forms are very interesting morphologically; some of the material sheds light on the development of abyssal Lepadidæ; and the whole collection reveals an unsuspected richness in the Cirriped fauna of the North Atlantic depths. Latin diagnoses of a score of new species are given.

Annulata.

Development of Nephelis vulgaris.¶—Herr D. Filatow discusses various obscure points in the development of this leech, e.g. the origin of the larval œsophagus by invagination, the digestive character of the

* Zeitschr. wiss. Zool., lxv. (1898) pp. 143–78 (1 pl. and 2 figs.).
† Zool. Anzeig., xxii. (1899) pp. 67–70. ‡ Journ. Morphol., xiv. (1897).
§ Ann. Nat. Hist., iii. (1899) pp. 27–39 (4 pls.).
‖ Bull. Soc. Zool. France, xxiii. (1898) pp. 189–98.
¶ Zool. Anzeig., xxi. (1898) pp. 645–7 (2 figs.).

œsophageal plate, and the development of the final œsophagus from the elements of the head blastoderm. But as the author allows, his results are not as yet altogether conclusive.

Gilson's "Musculo-Glandular Cells." *—Dr. J. Ogneff has studied the epithelium of the somatopleure in *Owenia*, in which Prof. Gilson described the existence of musculo-glandular cells,—a double differentiation in one element. But Ogneff has not been able to confirm this in the least; the muscular layer of the body-wall is quite distinct from the peritoneal elements. He blames the paraffin-method for what he regards as Gilson's mistake.

Vermiculus limosus.†—S. Hatai describes this new species, which is very common in the muddy gutters and ditches of Tokyo, occurring together with *Limnodrilus*, *Tubifex*, and other Limicolæ. It creeps about on the lower surface of fallen leaves and other objects, and rarely buries the anterior part of its body in the mud, as do most of the Limicolæ; nor does it swing the posterior part of its body like *Tubifex*. The general colour is milky-white, and the intersegmental lines are blood-red. It is very sluggish, and on being pinched, never executes writhing contractions, but simply retracts its body. These peculiarities serve to distinguish this species from its neighbours in the mud. It differs from the other known species of the genus—*Vermiculus pilosus* Goodrich—in having no clitellum, no oviduct, a single sperm-sac, cilia-like processes not uniformly distributed, and in some other points.

Black Oligochæte from Glaciers of Alaska.‡—Prof. C. Emery has a brief note on this (unnamed) form, which seems to represent a new genus of Enchytræidæ. Its most remarkable character is the black pigmentation of the epidermis, which appears to be unique, though there are some undescribed alpine forms of dark colour.

Glycera and Goniada. § — Ivar Arwidsson communicates some faunistic notes on *Glycera goësi* Malmgren, and a comparative study of the species of *Glycera* and *Goniada*, especially as regards the vascular system and its simplification in the course of development.

Nematohelminthes.

Unfertilised Ova of Ascaris megalocephala. — Prof. O. Hertwig ‖ has observed the behaviour of uterine ova in two specimens of *Ascaris megalocephala* which showed no trace of spermatozoa. At first the eggs behaved as if they had been fertilised; the germinal vesicle began to break up and to form a characteristic tetrad group of chromosomes. This group moved to the periphery, and took up the position of a directive spindle; but no well-defined spindle was formed. Meanwhile a firm vitelline membrane was formed, which remained closely apposed to the egg. No signs of parthenogenesis were observed.

Prof. M. Nussbaum ¶ recalls the observations which he made some

* Biol. Centralbl., xix. (1899) pp. 136–41.
† Annot. Zool. Japon., ii. (1898) pp. 103–11 (5 figs.).
‡ Arch. Sci. Phys. et Nat., vi. (1898) pp. 506–7.
§ Bihang k. Svensk. Vetensk. Akad. Handl., xxiii. (1898) No. 6 (30 pp., 2 pls.).
‖ SB. Akad. Wiss. Berlin, 1898, pp. 673–5 (3 figs.).
¶ Zool. Anzeig., xxii. (1899) pp. 77–9.

years ago * on the two kinds of unfertilised ova found in this worm. Some never pass beyond the long conical form which is normal at the time of separation from the rachis. As they are pushed forward in the uterus, their nucleus becomes multinucleolar. On the other hand, there is a second kind which change in form towards that of the fertilised ova; their nucleus begins to exhibit mitotic changes, but no expulsion of polar bodies is effected; they have a delicate primary vitelline membrane, which does not thicken as in the fertilised eggs, nor is a secondary vitelline membrane formed. In this second kind of unfertilised ovum, with which alone O. Hertwig dealt in his discussion of the matter (cf. *supra*), there is an egg-envelope formed by the uterine epithelium.

Œsophagus of Nematodes.†—Herr L. A. Jägerskiöld has made a minute study of the œsophageal region, especially in *Strongylus armatus* and *Dochmius duodenalis*. In parasitic forms which feed on more or less prepared foods, the bulbous portion and its glands may be more or less degenerate; and a consideration of this lends some general interest to the author's histological descriptions. He also describes ‡ *Chordodes Kallstenii*, a new Gordiid from Kameroon.

Vitality of Parasitic Nematodes outside their Host.§—Herr J. Dewitz removed some Nematodes from the connective tissue of the mackerel, and placed them in a watch-glass with a piece of sponge damped with salt water and cod-liver oil. They flourished well for a time, but most died in three months. The necessity of contact with a solid body is emphasised.

An Undetermined Parasite of the Ox.‖—A. Borgeaud describes the occurrence of nodules, like tuberculosis nodules, on the course of the blood-vessels in the wall of the small intestine of "charolaise" cattle. The nodules vary in size from that of a grain of wheat to that of a cherry-stone; they have a resistant capsule, and the contents are caseous, and sometimes calcareous. The smallest sometimes contain larval nematodes up to 3 mm. in length; and although no identification can be made without finding the adults, the shape of the mouth bears a resemblance to that of *Sclerostomum hypostomum*, near which the form in question should probably be placed. It does not seem to do much harm.

Nematodes of Birds.¶—Herr W. Volz makes a statistical report on the occurrence of Nematodes in birds. He gives a list of 24 forms, noting their hosts and the parts infected. Then follows a list of 32 birds examined with their respective parasites. The frequency of occurrence in the various organs is also noted.

Platyhelminthes.

Cestodes of Monotremes and Marsupials.**—Herr F. Zschokke describes *Bertia edulis* sp. n. and *B. sarasinorum* sp. n., both from *Phalanger*

* Arch. Mikr. Anat., xxiii. pp. 174–6.
† Bihang k. Svensk. Vetensk. Akad. Handl., xxiii. (1898) Afd. 4, No. 5 (26 pp., 2 pls.).
‡ Tom. cit., No. 7 (10 pp., 1 pl.).
§ Zool. Anzeig., xxii. (1899) pp. 91–2.
‖ CR. Soc. Vaudoise Sci. Nat., in Arch. Sci. Phys. et Nat., vi. (1898) pp. 648–9.
¶ Rev. Suisse Zool., vi. (1899) pp. 189–98.
** Zeitschr. wiss. Zool., lxv. (1899) pp. 404–45 (2 pls.).

ursinus; and gives a systematic diagnosis of the genus *Bertia* and the new genus *Linstowia*.

All the forms hitherto described satisfactorily from monotremes and marsupials belong to the sub-family Anoplocephalinæ, with the three genera *Moniezia*, *Bertia*, and *Linstowia*. There are interesting parallels between the species found in non-placental and those in placental hosts of similar habit.

New Genus of Tæniadæ.*—Dr. M. Lühe has studied various species of tapeworms found in lizards. He refers them to a new genus *Oochoristica*, and gives the following diagnosis:—Unarmed Tæniadæ, without a rudimentary rostellum; without axial "*Muskelzapfen*"; with marginal irregularly disposed genital apertures; and with a very rapid modification of the uterus, of such a nature that in the ripe proglottides the ova are found imbedded in the parenchyma.

New Cestode from Varanus.†—Herr E. Riggenbach describes *Scyphocephalus bisulcatus*, g. et sp. n. from *Varanus salvator*. It has three suckers, one terminal and two peripheral; the strobila is distinctly jointed; the genital apparatus is closely like that of *Bothriocephalus*; the genital openings are median and peripheral.

Unidentified Eggs.‡—Dr. T. Kanamori reports various cases where the eggs of some unidentified parasite were found associated with diseased conditions of the liver, the rectum, and the cerebral cortex in man. The same eggs seem to have been seen in five cases, but there was no trace of the parent animal. The author is on the outlook for a new parasite.

Tetracotyle Petromyzontis.§—Mr. H. W. Brown found large numbers of this Trematode in the brain-cavity of the lamprey. It is, he says, a remarkable fact that a vertebrate should live on, apparently without discomfort, whilst its brain is packed with hundreds of flukes. It may be doubted, however, whether our methods of observation are adequate to estimate the degree of cerebral comfort in a lamprey.

Parasite in Frog's Eye.‖—Herr Groenouw observed a small apparently living body in the vitreous humour of the frog's eye, but did not examine it microscopically. From the description Prof. M. Braun concludes that the parasite was *Diplostomum rachiacum* (= *Tylodelphys rhacidis*).

Incertæ Sedis.

Some Points in the Morphology of Enteropneusta.¶—Dr. A. Willey suggests a theory of gill-slits according to which these arose in the interannular depressions, while the gonads were disposed in zones corresponding with the epidermal annulations. The primary function of the gill-slits was the oxygenation of the gonads, their secondary function being the respiration of the individual. In most cases the gonads have been secondarily emancipated from the gill-clefts in correlation with the

* Zool. Anzeig., xxi. (1898) pp. 650–2. † Tom. cit., pp. 565–6.
‡ MT. Med. Facultät Univ. Tokio, iv. (1898) pp. 145–8.
§ Quart. Journ. Micr. Sci., xli. (1899) pp. 489–98 (1 pl.).
‖ Klin. Monatsbl. Augenheilkunde, xxxvi. (1898) pp. 60–62, 85–92 (1 fig.). See Zool. Centralbl., v. (1898) p. 842.
¶ Proc. Cambridge Phil. Soc., x. (1899) p. 37.

elaboration of the vascular system. In the author's opinion the evidence in support of this theory is overwhelming. A collective name, BRANCHIOTREMA, is suggested to include all animals with gill-slits, whether in the adult or in the embryo.

Rotatoria.

Rotatoria of the Basin of the Lake of Geneva.*—In the December number of this Journal of last year (p. 630) Dr. E. F. Weber's first part of this elaborate paper was noticed, and now the second part, dealing with the Ploima and Scirtopoda, has appeared. The author gives very good original figures, full of anatomical details, of the 88 species so far found by him in this district, and the text can be commended for its lucidity and exactness. In the whole paper, dealing with 123 species, only one is described as new; this is a lesson to the inexperienced students who so frequently describe new species of Rotifers by the dozen and by the score from a single small lake. Of slight changes introduced in the names, may be noticed that of *Furcularia lacinulata*, now called *Diaschiza lacinulata*, to which genus this species undoubtedly belongs. The genus *Sacculus* (Gosse) is changed into that of *Ascomorpha* (Perty) which has the priority in point of date. Three new families: PLOESOMADÆ, GASTROPODIDÆ, and ANAPODIDÆ, are created for the reception of the recent and aberrant genera *Ploesoma*, *Gastropus*, and *Anapus* respectively.

List of Rotifera found in the Illinois River at Havana, Ill.†—Mr. Adolph Hempel publishes this list with notes as to locality, frequency, seasonal distribution, &c., which gives a good idea of the work done at one of the various fresh-water biological stations, which have of late years been started by several Universities and State laboratories in America. 100 species are enumerated, but none that has not already been described.

Trochosphæra solstitialis.‡—During the past summer Mr. H. S. Jennings has found this very interesting and rare rotifer at another American station, a swamp adjoining Lake Erie, which is widely separated from the first station on the Illinois river, where Dr. Kofoid found it. A well-mounted specimen has reached this country, and has been exhibited at the March meeting of the R.M.S.

Echinoderma.

Development of Ophiura olivacea.§—Mr. C. Grave gives a preliminary account of the development of this Ophiuroid. For Echinoderms, the eggs of *Ophiura olivacea* Lyman are very large, with much yolk. They are quite opaque, and vary in colour from green to orange-yellow, but the eggs of one individual are constant in their coloration. Soon after fertilisation two membranes are formed. When 36 hours old, the larvæ are oval in form, and swim actively by cilia which cover the entire surface. The blastopore is shifted from the posterior end to a ventral position by the unequal growth of the ventral and dorsal sides. From the blastopore there protrudes the end of a cellular mass of material which almost fills the cavity of the archenteron, and also

* Rev. Suisse de Zool., v. (1898) pp. 355–785 (10 pls.).
† Bull. Illinois State Lab., v. (1898) pp. 301–88.
‡ Science, 1898, p. 551.
§ Zool. Anzeig., xxii. (1899) pp. 92–6 (5 figs.).

extends into the cavity of the pouch, which at this stage is being constricted from the free end of the archenteron. Twelve hours later the blastopore has closed, the posterior end of the archenteron lies loose in the larva except for its support from the mesenchyme, the anterior end bends over and fuses with an invagination which forms the mouth and œsophagus. Encircling the œsophagus lies the already five-rayed but horse-shoe-shaped hydrocoel. Lying on the top of the stomach and still connected with it, is the pouch which will form finally the hypogastric enterocœl of Goto.

On the left side, at the point where hydrocœl and enterocœl are in open communication, the pore-canal arises and passes dorsalwards. Dorsal to the stomach lies the pouch, which will ultimately form the epigastric enterocœl of Goto.

In a sixty-hour larva, the cilia are restricted to four transverse bands. The anterior end of the larva, which will enter directly into the formation of the star, is very much widened, and gives to the whole a club-shape. Encircling the mouth are five groups of rounded ectodermic elevations, due to the pushing out of the terminal tentacles and first pair of foot-tentacles. From the very first appearance of any part of the adult structure, it has a direct and constant relation to the larval body. In fact, in the life-history of *O. olivacea,* there is a complete verification of the conclusion arrived at by Goto in his study of the relation of the adult form to the larva in *Asterias pallida.*

Development of Ophiocoma echinata.*—Mr. C. Grave gives a short account of this. The orange-red eggs formed a prickly egg membrane after fertilisation. Regular segmentation resulted in a blastula with a very small cavity, which burst the chitinous membrane, and swam about, revolving on its long axis. At the time of hatching the mesenchyme formation began in a rapid proliferation of cells at the "vegetative pole," or "vegetable pole," as the author calls it. The gastrula is formed several hours later by the invagination of the same pole. From the apex of the flattened archenteron a pair of pouches are constricted off to right and left. Each divides into two, one of which remains in about its original position, while the other migrates towards the blastopore, and takes up a position on the side of that part of the archenteron which will later become the stomach. The right posterior pouch degenerates and disappears. Soon after their formation, the two anterior pouches both communicate with the exterior, through pore canals that open on the dorsal surface of the larva, which are not intra-cellular structures, but are lined with epithelium. At about the time of the formation of the pore-canals or a little before, the larval mouth breaks through on the ventral surface, and there is formed the perfectly bilaterally symmetrical larva. The right pore-canal sooner or later disappears, but persists slightly longer than the right posterior pouch, which is very transitory.

Species of Echinocardium.†—R. Koehler discusses the species of *Echinocardium* found in the Mediterranean, and gives more adequate diagnoses than heretofore of *Ech. cordatum*, *Ech. flavescens*, and *Ech.*

* Johns Hopkins Univ. Circ., xviii. (1898) pp. 6–7 (6 figs.).
† Rev. Suisse Zool., vi. (1899) pp. 173–87 (1 pl.).

mediterraneum, and now adds a fourth species *Ech. pennatifidum*, in regard to which he previously published a brief note.

Cœlentera.

Monogenesis in Metridium.*—Mr. H. B. Torrey finds that monogenesis is a well-established process in *Metridium fimbriatum*; longitudinal fission, laceration, and budding from œsophageal and foot regions occur. Monogenous individuals may be sexually mature.

The plane of division tends to pass through at least one siphonoglyph; but there is no apparent relation between the process of division and the number and position of the mesenteries. Laceration may be due to unfavourable environmental conditions. It may occur in dividing polyps. Buds arise from the œsophageal and foot regions; an œsophageal bud may occupy any position relatively to the siphonoglyph of the parent, and its siphonoglyph may be independent of that of the parent. Both budding and fission may occur in the same colony. Variation in the number of siphonoglyphs is not correlated with asexual reproduction. The monoglyphic and diglyphic types are not of the nature of varieties. That identical structures arise from quite different sources by different processes, is significant.

Are there Septal Funnels in Anthozoa?†—Dr. O. Carlgren discusses the alleged occurrence of septal funnels in larval sea-anemones, and is unable to confirm Goette's conclusion. After a study of eight embryos of *Bunodes gemmacea*, he has found no trace of septal funnels, beyond deceptive results of the contraction of the oral disc. He criticises Goette's instances, and maintains that the evidence will not hold. At present it seems to him unwarrantable to regard the scyphistoma as representing the ancestral form of Anthozoa and Scyphomedusæ.

Detachable Tentacles in Sea-Anemones.‡—Dr. O. Carlgren maintains that the members of the two genera *Polystomidium* and *Polyopis*, described by O. Hertwig as having rudimentary tentacles, are really forms in which the tentacles may be detached. Detachment of tentacles may occur not only in deep-sea forms, like *Bolocera* and *Polyopis*, but in littoral forms like *Boloceroides*. Of the last-named a diagnosis is given.

Relationships of Stichodactylinæ.§—Mr. J. E. Duerden discusses the Actiniarian genera *Corynactis*, *Rhodactis*, and *Ricordea*, which exhibit decided Madreporarian affinities. The *tout ensemble* is more decidedly Madreporarian than Actiniarian, as the author shows in detail. The suggestion which Gosse made, from external characters alone, of the close resemblance of *Corynactis* to the coral *Caryophyllia*, is supported in every important detail by anatomical study. Whether the forms in question are to be regarded as representatives of more ancestral anemones from which the skeleton-producing polyps may have taken their origin, or as coral polyps belonging to different families which have for

* Proc. California Acad. Sci., 3rd series, i. (1898) pp. 345–60 (1 pl.).
† Zool. Anzeig., xxii. (1899) pp. 31–9 (6 figs.). ‡ Tom. cit., pp. 39–44.
§ Journ. Linn. Soc. (Zool.), xxvi. (1898) pp. 635–53.

some reason lost the power of secreting a skeleton, must for the present be left an open question.

Some Ectosarcal Phenomena in the Eggs of Hydra.*—Prof. E. A. Andrews finds that, in addition to the various granular pseudopodia that accompany the remarkable cleavages of the eggs of *Hydra*, there are peculiar disturbances of the ectosarc; clear films and filaments being freely formed. These outgrowths of the ectosarc are formed when and where the parts of the egg are separated by considerable space, and extend out into such spaces. They undergo great changes of form and of bulk, and may suddenly emerge, withdraw, bend, or branch. At the bottom of cleavage furrows, when closing, such ectosarcal processes may reach across the cleft to the opposite cell or mass, and they may be concerned in the approximation and union of cleavage products. The phenomena are akin to those which the author calls "filose," and there is good reason to suppose them produced by such changes in the ectosarc as can at present be spoken of only as contractility. By contractions also in the material of the processes themselves, some, if not all, of their changes of form and size seem to be brought about.

Porifera.

Observations on Sponges.†—Messrs. G. C. J. Vosmaer and C. A. Pekelharing give an account of their observations on sponges. First of all, they deal with the nutrition, and state the results of feeding *Spongilla lacustris* and *Sycon ciliatum* with carmine and with milk. They believe that they are entitled to say that the choanocytes really are the organs by which particles suspended in the water, passing through the canals, are captured, and thus brought into the tissue of the body. A number of facts are cited which suggest that there is a whirling movement of the water in the flagellate chambers, and not a regular water current passing quickly through. The authors go on to show that the irregular motion of the flagella is not inconsistent with the regular current through the canals. Their explanation will hold good only if the current is in one direction, and the authors are unable to accept the observation that the current may be sometimes reversed.

In closing their discussion of the currents, the authors say, "We have in sponges an example of the height and fitness of organisation which can be obtained in Metazoa, without any co-ordination, by a mere appropriate arrangement of cells, which are differently developed according to their function. And yet, the evolution is soon limited, because the cells of the organism are not connected in such a way as to enable them to conduct stimuli from one cell to another; in other terms, because they are destitute of the principle the significance of which culminates in nervous tissue."

The second chapter deals with *Esperella ægagropila* (Johnst.) Tops., —its many synonyms, its structure, its degeneration after gemmule-forming, and so on. The third chapter discusses anisochelæ and isochelæ, their relations to one another and to other spicules. Finally, the authors describe the structure of the choanocytes, in regard to which they cannot confirm Bidder's description of parallel rods in the collar, or of "iris"

* Johns Hopkins Univ. Circ., xviii. (1898) pp. 1–3 (5 figs.).
† Verk. k. Akad. Wetensch. Amsterdam, vi. (1898) pp. 1–51 (4 pls.).

and "pupil" arrangement. Nor did they meet with any elements which could possibly be considered as intermediate stages between normal choanocytes and normal parenchyma cells. The isolation-method of studying the cells of sponges is strongly recommended.

Classification of Monaxonida.*—Prof. E. Topsent argues in favour of the following rearrangement. He recognises two sub-orders:—

I. Halichondrina, including Haploscleridæ, Pœciloscleridæ, and Axinellidæ.

II. Hadromerina.—Section A. Clavulida with monactinal megascleres, including the families Clionidæ, Spirastrellidæ, Polymastidæ, Suberitidæ, and Mesapidæ.

Section B. Aciculida (with diactinal megascleres), including the families Coppatiidæ, Streptasteridæ, Tethyidæ, and Stylocordylidæ.

Arctic Calcareous Sponges.†—Dr. L. L. Breitfuss has followed his previous studies on Calcarea with a catalogue of those known to occur in the Arctic region, which he divides into five sub-regions. The list includes 42 species.

Protozoa.

Reproduction of Ciliata.‡—Herr D. Joukowsky has repeated Maupas' famous experiments, and we see the need of caution in the somewhat different results reached by the two observers.

In *Pleurotricha lanceolata* over 458 generations were observed without the occurrence of degeneration. The size of the individuals depends mainly on the nutrition; the rate of multiplication varies markedly with the temperature; disturbances are apparently produced by the accumulation of waste products in the fluid. Degeneration seems, according to the author, to be due not to the number of generations merely, but to the rapidity of their succession.

After five months' culture, *Paramæcium caudatum* showed no nuclear degeneration, but a marked reduction of cilia and a resulting sluggishness. In *P. putrinum* effective conjugation between the descendants of one individual was observed, but the author admits the probability that this has its limits.

Pseudopodia in a Dinoflagellate.§—Dr. O. Zacharias observed on specimens of *Gymnodinium palustre* (one of the fresh-water Peridinieæ) the formation of pseudopodia in a manner very like that in *Diplophrys Archeri*. The fact is suggestive of the relationship, which Klebs has maintained, between the Gymnodinieæ and the Rhizomastiginæ. Schilling has described the protrusion of pseudopodia in *Gymnodinium hyalinum*, which is able to move by this means. This is not the case in *G. palustre*, where the pseudopodia are possibly nutritive, in relation to a probable—though unproved—saprophytic phase.

* Arch. Zool. Expér., vi. (1898) pp. 91–113.
† Arch. Naturgesch, lxiv. (1898) pp. 277–316.
‡ Verh. Nat. Med. Ver. Heidelberg, vi. (1898) pp. 17–42. See Zool. Centralbl., vi. (1899) pp. 42–3.
§ Biol. Centralbl., xix. (1899) pp. 141–4 (9 figs.).

Morphology of Craspedomonads.*—J. Kunstler seeks to show that the structure of these remarkable forms is not essentially different from that of other Flagellates. The anterior cavity, instead of being a simple flagelliferous cup, has been modified into a funnel of relatively large size. On the other hand, the spiral plate of the Craspedomonads ends in a simple buccal surface, while in other Flagellates there is an œsophageal tube or even a complex pouch.

Flagellata of the Upper Rhine.†—Dr. R. Lauterborn begins the fourth of his "Studies on Protozoa" with the remark that the meagreness of our knowledge of fresh-water forms is made plain enough by the fact that he has found five new genera of Flagellata in a limited area and (with one exception) within two years. The present instalment describes *Sphærœca Volvox*, *Bicosœca socialis*, *Thaumatonema setiferum*, *Hyalobryon ramosum*, *Chrysosphærella longispina*, *Mesostigma viride*, *Vacuolaria depressa*, and *Gymnodinium tenuissimum*. These eight species are all due to Lauterborn.

Rhizopods and Heliozoa of Fresh-water Plankton.‡—Dr. O. Zacharias notes that members of five species of Rhizopods and five species of Heliozoa are frequent and fairly constant components of the plankton in the lakes and ponds of the Plōn region. The former are:—*Dactylosphærium radiosum* Ehrb., *Difflugia hydrostatica* Zach., *Cyphoderia ampulla* Ehrb., *Diplophrys Archeri* Bark., and *Chrysamœba radians* Klebs; the latter are *Actinophrys sol* Ehrb., *Acanthocystis viridis* Ehrb. (= *A. turfacea* Cart.), *A. conspicua* Zach., *A. Lemani* Penard, and *Rhaphidiophrys pallida* F. E. Schulze. In small and shallow ponds the list of Rhizopods must be considerably extended. The author also notes Garbini's report of the occurrence of *Difflugia cyclotellina* and *Heterophrys Pavesii* in Lago Maggiore.

Coccidian of Octopus.§—M. Michel Siedlecki gives a very full account of *Klossia octopiana*, whose life-history may be summed up as follows. The sporozoites, emerging from the sporocytes, penetrate into the cells of the intestinal wall, and are there transformed into undifferentiated adults. Among these some undergo a multiple nuclear division, and give origin to *male elements* or *microgametes*, while the others exhibit certain nuclear changes and take on the characters of *female elements* or *macrogametes*. After the union of a microgamete with a macrogamete, the latter surrounds itself with a membrane and becomes an oocyst, while its nucleus (including male and female chromatin bodies) multiplies superficially by a succession of equal divisions, slightly suggestive of mitoses. Around each of the new nuclei a cytoplasmic body is gathered, and the *sporocysts* are thus produced. In the interior of each sporocyst, three or four *sporozoites* are formed, and the cycle is complete. It differs from that of other Coccidia in the absence of cellular multiplication (merozoite stage of Simond, eimerian stage of Léger) preceding the formation of the macrogametes. This simplification is interpreted in relation to the facility with which auto-infection seems to occur.

* Comptes Rendus, cxxvii. (1898) pp. 1232–4.
† Zeitschr. wiss. Zool., lxv. (1899) pp. 369–91 (2 pls.). Cf. this Journal, 1898, p. 203.
‡ Zool. Anzeig., xxii. (1899) pp. 49–53.
§ Ann. Inst. Pasteur, xii. (1898) pp. 799–836 (3 pls.).

BOTANY.

A. GENERAL, including the Anatomy and Physiology of the Phanerogamia.

a. Anatomy.

(1) Cell-Structure and Protoplasm.

Karyokinesis in the Root-tips of Allium.*—Mr. J. H. Schaffner summarises as follows the main results of a careful study of the formation of the achromatic spindle in the root-tips of *Allium Cepa*; the chief combination of stains used being anilin-safranin and gentian-violet, Heidenhain's iron-alum hæmatoxylin, and anilin-safranin and iron-alum hæmatoyxlin.

I. *Prophase.* (1) The division begins with the separation of the centrospheres; and when these have moved apart nearly 180°, the "incept"† of the achromatic spindle appears, forming two dome-like projections on opposite sides of the nucleus, at the summits of which the centrospheres are situated, forming the poles around which are cytoplasmic radiations. At the same time the chromatin network is transformed into a continuous ribbon or spirem, producing the figure known as the *close mother-skein.* (2) The continuous spirem shortens and thickens, and is looped into a definite number of loops, the heads of which, in typical cases, point towards the two poles of the spindle. The nucleoles and nuclear membrane disappear, and the dome-shaped spindle becomes more pointed by the outward extension of the poles. This stage ends with the breaking of the chromatic loops into separate chromosomes, and it may appropriately be called the *looped mother-skein.*

II. *Metaphase.* (3) After the nuclear membrane disappears, the separate chromosomes are drawn down, with their heads towards the centre, into the equatorial plane, while the spindle continues to become more pointed. This constitutes the *loose mother-skein* stage. (4) When the chromosomes have come into the equatorial plane, there is a pause resulting from the seeming pull of the spindle-fibres in opposite directions, which holds the chromosomes rigidly until their longitudinal splitting is complete, when separation of the daughter-chromosomes begins. This constitutes the *mother-star* stage.

III. *Anaphase.* (5) After the longitudinal segmentation of the chromosomes, which, as a general rule, does not begin until the chromosomes are in the equatorial plane, the daughter chromosomes are gradually pulled apart, the separation beginning at the heads of the loops. The centrosomes usually divide during this stage, though in some cases the division is considerably earlier. This stage is known as *metakinesis.* (6) The daughter-chromosomes, having been completely pulled apart, now travel to the poles, and arrange themselves in star-shaped figures around the poles, while the central spindle appears between the two stars. The radiations around the centrospheres, which now contain two

* Bot. Gazette, xxvi. (1898) pp. 225–38 (2 pls.).

† Used by the author instead of "primordium," as the equivalent of the German *Anlage.*

separate centrosomes, become more prominent. This is the *daughter-star* stage.

IV. *Telophase.* (7) The chromosomes, having arranged themselves around the poles, now begin to contract, becoming wavy in outline, and the free ends curve inward. The threads of the central spindle begin to thicken, preparatory to the formation of the cell-plate. In the centre of each thickened thread a granule appears, these being formed first in the central strands; and as the spindle bulges outward, the cell-plate gradually enlarges until it reaches the surrounding cell-wall. In the meantime the nucleoles begin to appear in the daughter-nuclei. This may be called the *loose daughter-skein* stage, and may be considered to end when the cell-plate is complete. (8) After the daughter-cells are completely separated by the new cell-wall, the threads of the central spindle disappear, and the daughter-nuclei appear with complete nuclear membranes. The chromosomes begin to be transformed again into the chromatin network; the radiations disappear from around the centro-spheres, which have now usually divided completely into two separate bodies; and the two daughter-nuclei in the meantime expand, and take on a more spherical form, until they enter again into the resting stage. This may be known as the *close daughter-skein* stage.

Cell-Division in Pinus.*—Mr. E. L. Fulmer has undertaken an examination of the process of cell-division in seedlings of *Pinus Laricio*, for the purpose of determining whether the achromatic spindle originates as a bipolar or a multipolar structure. The evidence obtained supports the former view. In the resting stage of the nucleus no centrospheres were observed. At about the time that the spindle becomes pointed, the spirem breaks up into a definite number of chromosomes, and the nuclear membrane disappears. At this time the nucleoles are no longer visible, having disappeared during the early prophase stage of division. The centrosomes in *Pinus* appear as small but definite and readily stained bodies lying at the poles.

Action of Gases on the Currents of Protoplasm and on Cell-division.†—Herr P. Samassa states that, in the staminal hairs of *Tradescantia*, pure oxygen does not accelerate the circulation of the protoplasm; while both hydrogen and carbon dioxide cause complete suspension. Contrary to the assertion of Demoor, he finds that, when oxygen is not present, no division of the nucleus takes place. No cyclosis of the protoplasm is exhibited in the terminal cells of the hairs while dividing.

(2) Other Cell-Contents (including Secretions).

Carbohydrate Reserve-materials of Bulbs and Tubers.‡—M. Leclerc du Sablon has studied the composition and the mode of formation and digestion of the reserve food-materials in a large number of bulbs, tubers, rhizomes, and corms. They always consist essentially of carbohydrates, such as starch, inulin, dextrins, and sugars, distinct or associated with one another. In the tubers of the potato, the rhizomes of

* Bot. Gazette, xxvi. (1898) pp. 239–46 (2 pls.).

† Verhandl. Natur-hist. Ver. Heidelberg, vi. (1898) Heft 1. See Bot. Ztg., lvi. (1898) 2[te] Abth., p. 344.

‡ Rev. Gén. de Bot. (Bonnier), x. (1898) pp. 353–69, 385–403, 447–82 (15 figs.). Comptes Rendus, cxxvii. (1898) p. 968.

Arum and *Iris*, and the corms of *Colchicum* and *Ranunculus*, the reserves are formed almost exclusively of starch, with small quantities of dextrin and sugar. In the tubers of *Ophrys* and the bulbs of *Lilium*, *Tulipa*, and *Hyacinthus*, starch is associated with dextrins; in the corms of *Ficaria*, with dextrin and non-reducing sugars. In the tubers of *Dahlia* we find inulin and levulin; in the tubers of the artichoke, inulin, levulin, and non-reducing sugars; in the bulbs of *Allium* and *Asphodelus*, chiefly reducing and non-reducing sugars.

The digestion of the carbohydrates is a very uniform process. Starch is transformed into dextrin, then into non-reducing sugars, then into reducing sugars. With inulin, the process is the same as with starch, but levulin takes the place of dextrin, and the last term is not glucose but levulose. *Stachys tuberifera* is exceptional in forming galactan, a substance intermediate between dextrin and sugar. In all cases the digestion of the carbohydrates is due to the action of a diastase.

In the formation of the carbohydrates, the processes are, as a rule, the inverse of those which take place in their digestion.

In biennials, the reserves are formed during the first, digested during the second year, with an intermediate period of rest. In perennial organs (rhizomes of *Iris* and *Arum*, tubers of *Dahlia*, &c.) the amount of reserve-materials reaches its maximum at the commencement, its minimum at the end of each period of vital activity. During each period of repose active internal transformations are going on, due to the action of the diastases formed from the protoplasm.

(3) Structure of Tissues.

Transformation of Alburnum into Duramen in the Oak.*—M. E. Mer has studied the mode of formation of the duramen out of alburnum in *Quercus Robur* and *pedunculata*. The duramen is characterised by a resorption of the starch in the ligneous and radial cells; by the appearance in these elements of a large quantity of tannin; by the production of thyllæ in the large vessels; and by the impregnation of tannin into the walls of all the elements, especially those of the vascular bundles. It was determined by observation and experiment that the entire disappearance of starch from the cortical region is not due to migration but to resorption, it being replaced by fresh starch which is being constantly formed in the leaves. The appearance of tannin coincides with the disappearance of the starch. The formation of thyllæ in the duramen is due to a renewal of cellular activity produced by hypernutrition. The main function of the alburnum is therefore to furnish a supply of nutriment for the production of the "perfect wood" (duramen).

Floral Fibrovascular System of the Bicarpellary Gamopetalæ.†—M. P. Grélot has studied the course of the vascular bundles in the flower of a large number of genera belonging to the bicarpellary Gamopetalæ (Gentianales, Polemoniales, Personales, Lamiales), and has come to the following general conclusions. The vascular bundles of the leaves,

* Ann. Sci. Nat. (Bot.), v. 1897 (1898) pp. 339–77. Cf. this Journal, 1896, p. 323.
† Tom. cit., pp. 1–154 (8 pls.).

whether foliar or floral, follow the modifications in the form, whether external or internal, and adapt themselves, to a certain extent, to the functions which they have to perform. In the stamens they are not unfrequently entirely suppressed. In the floral vascular bundles the phloem is always differentiated before the xylem. The procambial differentiation advances, in each bundle, from above downwards, and each bundle has an independent origin. The fibrovascular system of the primary stem is probably formed by the coalescence of the descending traces of foliar systems. The floral organs exhibit various modifications in the branching and anastomosing, and in the form of the bundles, in correlation with the transformations of the parenchyme which they contain.

Growth of Tracheal Elements.*—Herr A. Nathansohn confirms the statement of previous observers that, even in young and growing organs, the living protoplasm disappears from the tracheal elements soon after their complete development, and simultaneously with the lignification of their membrane. As the vessels, whether annular or spiral, still continue to increase, this must result in the separation of the rings in the former, and the greater inclination of the spiral in the latter case. In some cases, at all events, pitted vessels are formed only when growth in length has ceased.

Bursting of the Mechanical Ring in Climbing Plants.†—From the examination of a number of trees and shrubs belonging to different natural orders, Herr E. Schwabach states that a perfectly closed stereome-ring in the young stem occurs only in climbing plants. As the girth increases, this mechanical ring bursts, and at the same time the adjacent parenchyme cells rich in protoplasm force themselves, by their turgor, into the vacancies and distend them. This takes place so quickly that it is impossible to find such a cavity which is not filled up by meristematic tissue. The meristematic cells thus introduced thicken their walls and become transformed into stone-cells with extraordinary rapidity, and thus increase the mechanical function of the ring. The bursting usually takes place in the radial prolongations of the medullary rays, especially where the stereome-ring offers the least resistance. The penetration of the parenchymatous cells which adjoin the stereome-ring takes place on both the outer and inner sides of the ring.

Pneumathodes and Aerenchyme.‡—Herr A. Wieler doubts whether the so-called pneumathodes—e.g. those described by Jost in the roots of palms—are really organs of aeration. They appear to result from a stimulus exercised—in the case of roots—by the water on special groups of tissue, by which the epiderm is ruptured, and the injury healed by stoppage of the intercellular spaces. The formation of pneumathodes on the erect roots of palms may be explained by a conduction of the irritation from the submerged to the exposed area.

Raphid-Cells.§—Herr P. C. A. Fuchs has investigated the structure of raphid-cells, especially with the view of determining the question

* Jahrb. f. wiss. Bot., xxxii. (1898) pp. 671–86 (1 pl.).
† Bot. Centralbl., lxxvi. (1898) pp. 353–61 (1 pl.).
‡ Jahrb f. wiss. Bot., xxxii. (1898) pp. 503–24 (1 pl.).
§ Oesterr. Bot. Zeitschr., xlviii. (1898) pp. 324–32 (1 pl.).

whether they contain a nucleus or not; and finds this to be the case, apparently universally, in both Monocotyledons and Dicotyledons. They possess also a parietal layer of protoplasm, and contain a large quantity of mucilage. Where the raphids occur as isolated crystals, each is enveloped in a distinct sheath of its own; but the nature of this sheath, whether protoplasmic or cellulose, the author was unable to determine. The membrane of the raphid-cells presents no special peculiarities.

(4) Structure of Organs.

Protection of Geophilous Flowers.*—Prof. R. v. Wettstein describes the modes of protection of the flowers of geophilous plants, i.e. of those which, to a larger or smaller extent, form their floral organs underground. These he divides into two classes:—those in which the flower-buds escape from their envelopes while still beneath the soil, and emerge without their protection; and those in which they are still protected by these envelopes on their emergence. These classes are again subdivided into a number of types, each of which is illustrated in detail. In the first class, the inflorescence (or flower) is either erect or pendent, and the protecting structures are leaves, stipules, bracts, or hairs. Among illustrations of the various types may be mentioned *Mercurialis perennis*, *Anemone nemorosa*, *Orobus vernus*, *Eranthis hiemalis*, *Tussilago farfara*, *Adoxa moschatellina*, *Tulipa sylvestris*, &c. To the second class, among which there is again a great variety in the special adaptations, belong *Helleborus niger*, *Crocus*, *Paris quadrifolia*, *Allium ursinum*, *Galanthus nivalis*, *Leucojum vernum*, &c.

Pistil of Ranunculaceæ, Alismaceæ, and Rosaceæ.†—Mr. Ernst A. Bessey has studied the development of the pistil in these three orders, which present this in common,—that they all have two types of pistil, a uniovulate and a multiovulate (in Rosaceæ usually biovulate). The uniovulate pistil in all three orders represents a type in which an axillary structure appears, developing directly into the ovule in some cases; in others forming an axillary placenta on which the ovule is borne; while in others it unites with one lamina of the pistil and bears an ovule at its summit. The multiovulate (or biovulate) type is regarded by the author as having probably sprung from the last of these types among uniovulate pistils. The course of development of the uniovulate pistil is very similar in the three families.

Heterocarpy and Heterospermy.‡—Sig. L. Nicotra points out that when we get two forms of fruit in the same plant, as in many Compositæ, some species of *Ranunculus*, &c.; or two forms of seed, as in some species of *Suæda*, where some of the seeds have, while others have not, an endosperm; this is always connected with facilities for the dispersion of the seeds.

Classification of Fruits.§—Sig. L. Nicotra proposes several modifications in the terms at present applied to different kinds of fruit. He proposes the term *holocarp* (*olocarpio*) for an entire fruit resulting from a number of carpels, the product of each carpel being a "mericarp." The

* Abhandl. Deutsch. Natur.-Med. Ver. Böhmen, i. (1898) 19 pp., 2 pls.
† Bot. Gazette, xxvi. (1898) pp. 297–313 (1 pl.).
‡ Bull. Soc. Bot. Ital., 1898, pp. 213–7. § Tom. cit., pp. 115–22, 204–12.

holocarp may be an *apocarp* or a *syncarp*, depending on the degree of concrescence of the carpels; but these two forms pass insensibly one into the other. According to the arrangement of the carpels in a spiral or in a whorl, a holocarp is a *helicocarp* or an *actinocarp*, and furthermore, according to the position of the placentæ, it is *pleurospermic* or *antispermic*. The caryopsis differs but very slightly from the achene. The author regards the follicle as probably a primordial carpological type, from which are derived, in various directions, the legume, the single-seeded indehiscent achene, the siliqua, and the various forms of capsule.

Seeds and Seedlings of Amentiferæ.*—Mr. W. W. Rowlee and Mr. G. T. Hastings give the following information on this subject. The cotyledons in *Juglans* and *Hicorius* (*Carya*) correspond to the valves of the nut, and are deeply two-lobed. The two divisions of the embryo resembling cotyledons are each made up of halves of the cotyledons. In *Castanea* and *Quercus*, the shell is split in germination by a swelling of the cotyledons. In *Fagus* alone (among Amentiferæ), the hypocotyl lengthens so as to bring the cotyledons above the surface.

Phytostatic Law of Branching.†—Dr. L. J. Celakovsky recalls the law of branching previously enunciated by him under the term "phytostatic":—In every branching, in the widest use of the term, the strongest branch developes from the first terminally, the weaker one laterally; but two equally strong branches develope at the same angle to the parent-branch. Any structure may arise at one time as the stronger, at another time as the weaker, at another time as an equally strong branch. From this it follows that the terminal or lateral position is entirely independent of the morphological value of the branch. This law is now illustrated by a great wealth of examples.

As a rule the "primordium" (*Anlage*) of an axillary bud is much weaker than the growing point of the parent shoot. In the vegetative region it usually arises in the axil of a deeply placed leaf-primordium; but in the inflorescence, almost always in that of the uppermost leaf, in a lateral position beneath the terminal growing point. Hence arise three different branching systems, connected by transitional forms. The author proposes to suppress altogether the term "monopodial," and to call the two-branch system indicated by the above difference "pleuroblastic" and "acroblastic," while the term "dichotomous" is replaced by "dichoblastic" when the repeated dichotomy develops into a sympodium. The same branch-system or the same inflorescence may, even in the same plant, develop in a pleuroblastic or in an acroblastic manner, or in an intermediate (dichoblastic) fashion.

Stem of Anemone.‡—M. E. de Janczewski gives a detailed account of the general structure of the stem—epigæous, hypogæous, and perigæous—in this genus, with a special description of its distinguishing characters in the various sections and genera.

Classification of Leaves.§—Prof. A. Hansgirg proposes to classify the various forms of leaves, in accordance with their biology, under

* Bot. Gazette, xxvi. (1898) pp. 349–53 (1 pl.).
† Jahrb. f. wiss. Bot., xxxii. (1898) pp. 323–60 (1 pl.).
‡ Rev. Gén. de Bot. (Bonnier), x. (1898) pp. 433–46, 507–18 (4 pls.). Cf. this Journal, 1898, p. 212.
§ Oesterr. Bot. Zeitschr., xlviii. (1898) pp. 430–4.

27 types, arranged in six groups, three of these belonging to aquatic or marsh plants, and three to terrestrial plants. The first group includes the submerged leaves of aquatic plants, of the *Vallisneria*, *Myriophyllum*, and *Isoetes* types; the second, floating leaves of the *Nymphæa* type; the third, leaves of bog-plants adapted to an aquatic life, of the "flooded" and *Arum* types. The fourth group comprises those which present adaptations for the promotion or checking of transpiration, xerophytes, halophytes, &c.; the fifth, those provided with mechanical or chemical protections against consumption by animals, or with contrivances for the capture of insects; the sixth group embraces the scale-leaves of parasites, epiphytes, and saprophytes, of the *Lathræa* and *Viscum* types.

Special Adaptation of Leaves.*—Prof. F. Czapek notes that in *Cirsium eriophorum*, when growing in sunny localities, the leaves have two rows of comb-like pinnæ which stand erect; while when growing in the shade, all the pinnæ are expanded flat. We have here an evident adaptation to different degrees of illumination.

Leaves of Cecropia.†—The leaves of *Cecropia* have hitherto been but imperfectly described, owing to their enormous size. According to Herr A. Richter, they are characterised by large intercellular spaces, which are grouped in the hypodermal parenchyme of the larger veins which project on the under side of the leaf, round the vascular bundles. No latex-tubes containing caoutchouk could be detected.

Pearly Glands of the Vine.‡—M. J. Dufour gives an anatomical account of these structures, which appear especially on the young shoots of the vine in spring. They contain an oil, which increases in quantity with the age of the gland, and are probably organs of secretion.

Nature and Origin of Stipules.§—From a study of the stipules in a large number of Monocotyledons and Dicotyledons, Mr. A. A. Tyler has come to the following general conclusions.

The sheathing petiole has its origin independently of the true petiole, and is formed by a concomitant development of the lateral and central-basal portions of the primitive leaf. The ligule (Gramineæ, &c.) is a special development of the apical parts of the lateral portions of the primitive leaf along the ridge between the sheathing petiole and the distal parts of the leaf. The ochrea (Polygonaceæ) is related to the ligule, and is generally associated with the sheathing petiole. It consists of the apical tissues developed in those cases where the sheathing petiole completely surrounds the stem, or did so in the ancestral condition. The lateral portions of the primitive leaf, when separated in greater or less degree, constitute stipules in the usual acceptation of the term; but they may be variously modified by subsequent evolutionary changes. The lateral portions of the primitive leaf represent potentially the ligule, the ochrea, and the margin of sheathing petioles and stipules; but they are often incorporated with the other portions as the wings of petioles, and as lateral basal portions of leaf-blades.

* Oesterr. Bot. Zeitschr., xlviii. (1898) pp. 369–71 (1 fig.).
† Biblioth. Bot., Heft 43, 1898, 25 pp. and 8 pls.
‡ Arch. Sci. Phys. et Nat., vi. (1898) p. 647.
§ Ann. N.Y. Acad. Sci., x. (1898) pp. 1-49 (3 pls.). Cf. this Journal, 1895, p. 653.

Bristles of Cirsium horridum.* — According to Herr A. N. v. Archenegg, the bristles on the upper surface of the leaves of this and of other allied species of *Cirsium* are not trichomes, but are of the nature of emergences. They consist of thick-walled lignified and pitted prosenchymatous cells, which are prolonged in a bundle through the parenchyme of the leaf to the end of a vascular bundle, passing into it, and being gradually replaced by tracheids. The function of these structures is not certain, but they probably act as organs for the absorption or storing up of water.

Stopped Stomates.† — Herr Th. Wulff finds the closing of the stomates by a layer of wax, hitherto chiefly known in the Coniferæ, to be a widely spread phenomenon, having evidently for its object the reduction of transpiration. The greatly reduced transpiration of the Coniferæ, as compared to that of Angiosperms (about 1 : 6), is largely due to this. Even when the stomate is not closed on the outside, the same result takes place from a partial closing of the communication between the pore and the internal air-chamber. The wax-stopper does not consist of a homogeneous structure, but of rounded or angular granules. It appears to be formed from the guard-cells themselves, or from epidermal cells contiguous to them. Even when transpiration is greatly hindered, this is not the case with the decomposition of carbon dioxide, that gas diffusing readily through a thin layer of wax. In all succulent plants examined, the stomates were entirely free from wax. The phenomenon is very common in grasses.

Stomates on the Perianth and Anthers.‡ — Sig. A. Antony supplies additional lists of plants in which stomates are, and are not, found on the perianth. In the species of *Narcissus* examined, stomates were found on both perianth-whorls, and on both surfaces; also on the corona and on the connective, but not elsewhere on the stamens. In the snowdrop they occur on the inner surface of the outer (upper), and on both surfaces of the inner perianth-whorl; also on the anthers and filaments; in the wallflower, only on the lower surface of the petals. The spathe of *Arisarum* possesses stomates of a special structure, which necessitates their being always open; while in the spathe of *Arum*, *Calla*, *Dracunculus*, and other Araceæ, the stomates are of the normal type.

Root-tubercles of Leguminosæ.§ — M. D. Clos has collected together all the facts at present known with respect to the root-tubercles of Leguminosæ, with an explanation of all the new terms brought into use with regard to geotropism and heliotropism, and a statement of the bearings of recent discoveries on practical agriculture.

Green Hemi-parasites.‖ — Herr H. Heinricher continues his researches on this subject, especially with reference to the genera *Euphrasia* (*E. salisburgensis*, *Rostkoviana*, and *minima*), *Alectorolophus*, and *Odontites*. The different species of *Euphrasia* display very different degrees of

* Oesterr. Bot. Zeitschr., xlviii. (1898) pp. 409–13 (1 pl.).
† Tom. cit., pp. 201–8, 252–8, 298–307 (1 pl.).
‡ Bull. Soc. Bot. Ital., 1898, pp. 170–8. Cf. this Journal, 1898, p. 95.
§ Journ. Agric. prat. pour le midi de la France, 1898, 18 pp. See Bull. Soc. Bot. France, xlv. (1898) p. 321.
‖ Jahrb. f. wiss. Bot., xxxii. (1898) pp. 389–452 (2 pls. and 1 fig.). Cf. this Journal, 1898, p. 209.

parasitism; *E. Rostkoviana* being a very strongly developed parasite, while *E. minima* exhibits a large degree of independence. It is not uncommon for haustoria from the same individual to attach themselves to several different host-plants, and the number of such host-plants is very large. *Alectorolophus* (*Rhinanthus*) is an obligatory parasite, and appears to thrive best on grasses. The absence, in the Rhinanthaceæ, of the power of independent development depends on the reduction, or entire suppression, of the activity of the root-system, and this on the absence of root-hairs. The parasite exercises a distinctly injurious effect on the vitality of the host-plant.

Structure of Rosaceæ.*—M. P. Parmentier gives a detailed account of the anatomical structure of this order, with an essay on a natural classification of the species, and an anatomical description of the species properly so called, and of the "morphological species." He finds useful taxonomic characters in the size and form of the stomates.

Structure and Classification of the Buxaceæ.†—According to M. P. van Tieghem, the Buxaceæ must be removed from the Euphorbiaceæ, with which they are usually associated, and placed among Dicotyledones, near to the Ranunculaceæ and Geraniaceæ. He divides the order into two sub-orders, the Buxeæ (*Buxus*, *Buxanthus*, *Buxella*, *Notobuxus*), characterised by opposite decurrent leaves and nodal intercalary growth, the androgynous inflorescence terminating in a female flower which has a double perianth, the fruit a drupaceous capsule; and the Pachysandreæ (*Tricera*, *Sarcococca*, *Pachysandra*, *Styloceras*), where the leaves are single and not decurrent, the growth internodal, the androgynous inflorescence with the female flowers at the base, and with a triple perianth, the fruit indehiscent and berry-like. The genus *Simmondsia* is removed from the order.

Structure of Nuytsia.‡—M. P. van Tieghem calls attention to several interesting points of structure in this type of the small Australian order Nuytsiaceæ, allied to the Loranthaceæ, but not parasitic. The fruit occupies an intermediate position between the achene and the berry. The embryo is destitute of any trace of radicle, and the number of cotyledons is usually 4, less often 3. In the absence of a radicle the structure of the embryo agrees with that of most Loranthaceæ, and of some genera belonging to other orders, as *Trapa*, *Ceratophyllum*, and some palms. The radicle is formed only during germination, and is then of endogenous origin, springing from the interior of the hypocotyl. The peculiar structure of the mature leaves, where the function of secretion is confined to the oily epiderm, is not manifested in the young seedling. The same is the case with regard to the peculiarities in the internal anatomy of the stem.

β. Physiology.

(1) Reproduction and Embryology.

Fertilisation of Salisburia.§—Prof. S. Hirasé publishes another contribution to our knowledge of the process of fertilisation in *Salisburia*

* Ann. Sci. Nat. (Bot.), vi. 1897 (1898) pp. 1–175 (8 pls.).
† Op. cit., v. 1897 (1898) pp. 289–338.
‡ Bull. Soc. Bot. France, xlv. (1898) pp. 213–20.
§ Journ. Coll. Sci. Tokyo, xii. (1898) pp. 102–49 (3 pls., 2 figs.). Cf. this Journal, 1897, p. 140.

adiantifolia (*Gingko biloba*). The mature pollen-grain consists of three cells of unequal size. The largest is the vegetative cell; a small intermediate cell is the antheridial cell; the smallest exterior cell takes no active part in the process. From the largest cell is produced the pollen-tube, which branches, and spreads over the inner surface of the nucellus; the apex of one of these branches comes into contact with the neck-cells of the archegone. The nucleus of the intermediate cell divides, and the cell divides into a body-cell and a stalk-cell. The body-cell again divides, and two attraction-spheres appear at its poles. The daughter-cell is transformed into antherozoids, two in each pollen-tube. The centrosome elongates into a slender filament. The body of the antherozoid has, at its head, three spiral coils, on which the cilia are formed out of the centrosome. The antherozoids escape from the mother-cell, and swim freely in the liquid contained in the pollen-tube.

Fertilisation in Cycas.*—Prof. S. Ikeno gives further details of the development of the sexual organs and the process of impregnation in *Cycas revoluta*. The former agree essentially with those in other Gymnosperms.

In the formation of the archegone, three periods may be distinguished,—the "primordium" period, the growth period, and the maturity period. The pollen-grain consists of two small prothallium-cells and a large embryonal cell. Shortly after pollination, the pollen-grain produces a tube which penetrates the nucellar tissue. The nucleus of the inner prothallium-cell divides into a body-cell nucleus and a stalk-cell nucleus. The latter is pushed aside; while in the former appear two centrosomes, which rapidly attain a very large size. The embryonal cell nucleus follows the body-cell nucleus, so that, shortly before the formation of the antherozoids, the outer prothallium-cell nucleus, the body-cell nucleus, the nucleus of the embryonal cell, and that of the pedicel-cell, all meet at the closed end of the pollen-tube. Shortly before impregnation, the nucleus of the body-cell or spermatogenous cell divides into two nuclei, and the cell itself into two spermatids. The nucleus of each spermatid developes into an antherozoid with a nucleus and a tail composed of cytoplasm. Shortly before, or shortly after, the entrance of the antherozoid, a crater-like cavity is formed in the nucleus of the oosphere, into which the antherozoid enters in order to fuse with the oosphere-nucleus, penetrating gradually deeper into the latter.

Fertilisation of Ulmus.†—M. S. Nawaschin has studied the progress of the pollen-tube in two species of elm, *Ulmus pedunculata* and *montana*, and regards it as exhibiting a phenomenon intermediate between chalazogamy and porogamy. The ovary is unilocular—not bilocular, as some have considered—and contains a single pendent ovule. The course of the pollen-tube in *Ulmus* is not uniform. In the great majority of cases it penetrates the tissue of the funicle close to its edge, and then pierces the inner integument to reach the apex of the nucellus. In other cases the pollen-tube branches profusely, and shows a distinct tendency to grow outside the tissue of the nucellus. In other cases, again, the pollen-

* Jahrb. f. wiss. Bot., xxxii. (1898) pp. 557–602 (3 pls., 2 figs.). Journ. Coll. Sci. Tokyo, xii. (1898) pp. 151–214 (8 pls.). Cf. this Journal, 1897, p. 140.

† Bull. Acad. Imp. Sci. St. Pétersbourg, viii. (1898) pp. 345–57 (1 pl.). See Bot. Centralbl., lxxvii. (1899) p. 26.

tube follows the same course as in typical chalazogamous types. No special conducting or nutritive tissue for the pollen-tube occurs in the elm. The phenomena appear to exhibit a tendency to abandon the primitive chalazogamic in favour of the later acquired porogamic habit. In this respect they stand on a par with those in *Cannabis*.* Fertilisation takes place on the third or fourth day after pollination. The embryo-sac frequently displays anomalies, e.g. in the number of antipodals.

Embryogeny of Allium.†—Mr. C. J. Elmore has followed the development of the embryo in several species of *Allium* (chiefly *tricoccum*, *cernuum*, and *canadense*), with the view of determining the probability of the occurrence of polyembryony. Out of 75 embryo-sacs of *A. tricoccum*, only 16 contained antipodal cells; and in 95 of *A. cernuum*, there were only 29 with antipodals. When antipodals were present, they were but feebly developed; and there was no evidence whatever of any tendency on their part to develop into embryo-sacs; they had usually disappeared at an early stage of development.

Embryology of Alyssum.‡—The following are the more important conclusions attained by Lumina C. Riddle from a study of the development of the embryo-sac in *Alyssum macrocarpum*. The hypodermal archesporial cell divides into a tapetal cell and a megaspore-mother-cell, the latter giving rise to four megaspores, three potential megaspores, and a "vital" megaspore which developes into the embryo-sac. The antipodals disappear during the early stages of the development of the embryo. The endosperm appears soon after the fertilisation of the oosphere. The number of cells in the suspensor varies from 6 to 15; the number beyond 6 apparently depending on the number of intercalary divisions, some of which may be longitudinal. The endosperm lines the entire embryo-sac with a single layer of cells, but is more abundant round the young embryo, and forms a peculiar growth in the antipodal region.

(2) Nutrition and Growth (including Germination, and Movements of Fluids).

Metastasis in Halophytes.§—By a halophyte Herr L. Diels understands a plant that has the power of decomposing chlorides so as to make them innocuous. He found that when such plants are grown in distilled water, or in water almost free from salts, the percentage of sodium chloride contained in them diminishes. This is accompanied by an increase in the amount of malic acid; but the nature of the chemical process is not clear; it seems probable that the chlorine combines with hydrogen, and is excreted through the root. This increase of malic acid is rendered possible from the diminished transpiration resulting from the xerophilous structure of halophytes, especially the reduction of the stomatic apparatus.

Chlorophyll Assimilation of Limodorum abortivum.‖—This terrestrial orchid is regarded by M. E. Griffon as intermediate between those which have green leaves and which also possess a mycorhiza, like many

* Cf. this Journal, *ante*, p. 47.
† Bot. Gazette, xxvi. (1898) pp. 277–8. ‡ Tom. cit., pp. 314–24 (3 pls.).
§ Jahrb. f. wiss. Bot., xxxii. (1898) pp. 309–22.
‖ Comptes Rendus, cxxvii. (1898) pp. 973–6.

species of *Orchis*, and the non-chlorophyllous saprophytic species like *Neottia nidus-avis* and *Corallorhiza innata*. Although *Limodorum* contains abundance of chlorophyll, the chloroleucites are masked by a great quantity of a violet pigment in the stem, leaves, and all parts of the plant; in consequence it has but little power of decomposing carbon dioxide directly, and the respiration is always considerably in excess of the assimilation.

Elongation of Nodes.*—M. P. van Tieghem points out that the increase in length of an axial organ is not always due to the lengthening of the internodes only; the nodes may take a share in this elongation, or it may even take place exclusively in them. This occurs, e.g., in the cotyledonary node of Cyperaceæ and Gramineæ, and in the short branches of various Coniferæ. In the genus *Buxus* the author describes three distinct modes of elongation of the axis.

Biology of Helleborus fœtidus.†—Prof. F. Ludwig points out the various contrivances by which this plant adapts itself to its enviromental conditions, especially the following:—The plant has two distinct forms of leaves, winter and summer, or "chionophilous" and "chionophobous" leaves. The summer leaves have broad strongly serrate lobes; while the winter leaves are thicker and have narrower entire segments. When the temperature falls below the freezing point, they deflect their petioles so as completely to protect the plant against cold and snow. This protection enables the inflorescence to develop very early in the spring, when the flowers are pollinated by Hymenoptera. The ripe seeds bear a remarkable resemblance to Coleoptera-larvæ, and are carried away by ants, which play an important part in their dissemination.

Sap-pressure.‡—According to Dr. W. Figdor, the phenomena of sap-pressure (*Blutungsdruck*) differ widely in temperate and in tropical climates. In the tropics (Java) there is always, in contrast to the prevalent conditions in our latitudes, a positive sap-pressure which varies greatly in intensity in different plants. It is not unfrequently three times as great as in our climate. In one instance a pressure of more than eight atmospheres was measured. Even in the same plant the sap-pressure may vary greatly in the course of 24 hours; these variations being due not exclusively to a periodicity, but also to external factors, such as transpiration.

Transpiration in the Tropics and in Central Europe.—Herr E. Giltay § replies to the criticisms of Haberlandt on his previous statements, and especially lays stress on the view that the method adopted by Haberlandt of registering the amount of transpiration from cut leaves and branches is not a reliable one.

To these objections Haberlandt ‖ makes a final reply.

Elective Absorption of Mineral Elements by Plants.¶—By growing very young plants in very dilute mineral solutions, M. E. Demoussy has

* Ann. Sci. Nat. (Bot.), v. 1897 (1898) pp. 155–60.
† Oesterr. Bot. Zeitschr., xlviii. (1898) pp. 281–4, 332–9 (3 figs.).
‡ SB. k. Akad. Wiss. Wien, May 20, 1898. See Œsterr. Bot. Zeitschr., xlviii. (1898) p. 359.
§ Jahrb. f. wiss. Bot., xxxii. (1898) pp. 478–502. Cf. this Journal, 1898, p. 417.
‖ Op. cit., xxxiii. (1898) pp. 166–70.
¶ Comptes Rendus, cxxvii. (1898) pp. 970–3.

determined their elective power of absorption of the salts of certain mineral elements over those of others. Thus the presence of potassium will greatly lower, or even reduce to zero, the absorption of sodium.

(3) Irritability.

Geotropic Irritation-Movements.*—Prof. F. Czapek compares the movements of irritation in plants with the reflex movements in the animal kingdom, even in respect to the different periods into which they may be divided. The period of impact he terms the "presentation period," that between the commencement of the irritation and the commencement of the reaction is the "reaction period"; the "impression period" is that during which an organ retains the capacity to react to an irritation, when prevented from executing its movement at the moment of irritation. The geotropic presentation period extends, as a rule, to about 15 minutes at 25° C.; the heliotropic presentation period is shorter, i.e. plants are more quickly sensitive to light than to gravity. The sensitiveness increases with a rise of temperature. Chemical reagents act in a similar way.

Microscopic investigation has failed to detect any difference between an irritated organ and one not irritated. Microchemical examination, on the other hand, indicates an increase, under the influence of geotropic stimulus, of aromatic oxidisable, and a decrease of oxygen-carrying substances (in root-tips and the apex of the cotyledons of grasses), but this is not the case with heliotropic stimulus.

By the term *Æsthesia* the author expresses the capacity of an organ to respond to definite physical stimuli; it may take the form of "photo-," "geo-," or "chemo-æsthesia." The phenomena of this reaction may be classed under the following heads:—(1) *Taxis* or movement ("geo-" or "photo-taxis"); (2) *Tropism* or curvature; (3) *Strophism* or twisting; (4) *Trophy* or increase in thickness; (5) *Auxesis* or new formation of organs; (6) *Stasis* and *Dolichosis*, the acceleration or retardation of growth in length. The author further adopts Sachs's term *Anisotropy* for the inequality in the external response to reaction.

Irritable Movements in Marantaceæ.†—Mr. C. H. Thompson describes some movements in the flower of Marantaceæ (*Maranta*, *Calathea*, *Thalia*), which are evidently adaptations for promoting cross-pollination. In all the species one of the staminodes is developed into a keel-like structure, which at maturity enfolds the style. On the margin of the keel, about midway between the apex and the base of the staminode, is a tentacle-like body, which is extremely irritable. In the open flower this tentacle guards the way to the flower. When the tentacle is irritated, the impulse is conveyed to the sheathing base of the keel, opening it, and allowing the style to escape. The style forms a semicircle, and the stigma violently strikes the visiting insect which has irritated the tentacle, or that part of its body which has already become dusted with pollen.

* Jahrb. f. wiss. Bot., xxxii. (1898) pp. 175–308 (7 figs.).
† Acad. Sci. St. Louis, Oct. 17, 1897. See Bot. Gazette, xxvi. (1898) p. 371.

Traumatropic Movements of the Nucleus and of Protoplasm.*—Dr. A. Nestler states that movements of this nature are very frequent in the vegetable kingdom. They were observed in various organs in Phanerogams and in Algæ; the nucleus and protoplasm moved towards the side of the cell which faces the wounded surface. The maximum irritation usually takes place in two or three days. The newly occupied position may be permanent, or the nucleus and protoplasm move back to their previous position. This traumatropic sensitiveness admits of no mechanical explanation, but appears to be a property of living protoplasm. It may extend to a distance of 0·5–0·7 mm. from the wound. The nucleus sometimes swells to an abnormal size.

(4) Chemical Changes (including Respiration and Fermentation).

Formation of Starch in Chromatophores.†—From observation and experiments made on a variety of plants, Herr H. Winkler has come to the conclusion that the chloroplasts, not only of leaves from which the starch has been removed, but also, with certain exceptions, those of other plants, in whose leaves no starch is found in the normal condition, can produce starch out of organic nutrient substances conveyed to them; and that this capacity is not lost by etiolated leaves. In the autumnal decay of foliage it may be retained as long as the stroma of the disorganising chlorophyll-grains remains intact. The leucoplasts which are found in the various tissues of plants, as far as they do not yet contain starch in the normal condition, possess, with a few exceptions, this capacity when treated with sugar. It appears to follow from this that the formation of starch is, at least originally, a special function of the chromatophores of the higher plants.

Formation, Storage, and Depletion of Carbohydrates in Monocotyledons.‡—Mr. A. Parkin finds the amount of starch produced by normal assimilation to vary greatly in different plants, and to have some relation to the form and distribution of the leaves. Inulin is not uncommon in many genera of Monocotyledons, e.g. in *Scilla nutans* and *Galanthus nivalis*; inulin and starch may co-exist in the same cell. Inulin is never produced by aquatic species.

Formation and Transformation of Lecithin.§—Herr J. Stoklasa states that in lupins kept in the dark, the decomposition of albumin, the formation of asparagin and glutamin, and the decomposition of lecithin, take place not only in the leaves, but also in the root-tubercles. Lecithin is always an accompaniment of the albuminoids, and is decomposed as a consequence of the darkening of the green leaves. The formation of lecithin and of the albuminoids depends on photosynthetic assimilation. In Fungi these substances are formed in a different way.

Indigo Fermentation ‖—According to Prof. H. Molisch, the transformation of indican into indigo-blue in *Indigofera* is not due, in the

* SB. k. Akad. Wiss. Wien, July 7, 1898. See Bot. Centralbl., lxxvi. (1898) p. 42.
† Jahrb. f. wiss. Bot., xxxii. (1898) pp. 525-56.
‡ Proc. Roy. Soc., lxiv. (1898) pp. 122–3.
§ Hoppe-Seyler's Zeitschr. f. Physiol. Chemie, 1898, p. 398. See Bot. Centralbl., 1898, Beih., p. 202.
‖ SB. k. Akad. Wiss. Wien, July 7, 1898. See Oesterr. Bot. Zeitschr., xlviii. (1898) p. 361.

first place, to the action of bacteria; whether within or without the dead cell, oxygen is indispensable to the process. It is accompanied by a number of different bacteria, and not by a single species as previously supposed, and mould-fungi are also present. In some cases (seedlings), indican is formed only in the light; in other cases, both in the light and in the dark, but always more abundantly in the light. The following species, in addition to *Indigofera*, are named as indigo-plants:—*Echites religiosa*, *Wrightia antidysenterica*, *Crotalaria Cunninghamii*, *C. turgida*, *C. incana*.

Influence of Oxygen on Fermentation.*—Dr. G. Korff, in his rerearches on the influence of oxygen on fermentation, fermentation-energy, and reproductive power, in different yeast races under different conditions of nutrition, worked with pure cultures of Saaz, Frohberg, and Logos yeasts, and used solutions of cane-sugar or yeast-water and asparagin solution as nutritive media. The following general conclusions were arrived at.

(1) Moderate aeration may favour the reproductive energy and reproductive power (Saaz and Frohberg), or lessen it (Logos).

(2) Moderate aeration may raise the fermentation energy (Saaz and Logos), or lessen it (Frohberg).

(3) Moderate aeration either favours the fermenting power (Frohberg and Logos), or is without influence (Saaz).

(4) Oxygen always increases the reproductive energy; and

(5) Also the reproductive power, though moderate aeration may be even more favourable (Frohberg).

(6) Oxygen diminishes the fermentation energy and power in all cases.

(7) Hydrogen or total deprivation of oxygen inhibits the reproductive energy (Saaz and Logos), or is without influence (Frohberg).

(8) Hydrogen always causes a reduction of reproductive power; and

(9) Either induces a reduction of fermentation energy (Saaz and Frohberg), or is without influence.

(10) Hydrogen augments the fermenting power (Frohberg and Logos), or exerts no influence (Saaz).

Hence, under the given conditions, it would seem that reproductive power and energy, and fermentative power and energy, are, as far as these three yeasts are concerned, inversely proportional. The three illustrations show the ingenious apparatus used by the author in his experiments. For these and the numerous details of the experiments the original should be consulted.

γ. General.

Origin of Gymnosperms and the Seed Habit.†—In his retiring Address as President of the Botanical Society of America, Prof. J. M. Coulter thus sums up his general conclusions on this subject.

A great *Cordaites* plexus, more extensive than the one usually included under that name, represented the characteristic Palæozoic seed-plants. It was probably derived from homosporous eusporangiate Filicales,

* Centralbl. f. Bakt. u. Par., 2te Abt., iv. (1898) pp. 465–72, 501–7, 529–35, 561–9, 616–27 (3 figs.).

† Bot. Gazette, xxvi. (1898) pp. 153–68.

represented to-day most abundantly by the *Marattia* forms and their allies, and was the most common Palæozoic type of Filicales. From it the Gymnosperm lines, at least the Cycads and Conifers, were derived. The frequent independent appearance of heterospory probably results from inequalities of nutrition in connection with the development of antherids and archegones. The retention of the megaspore, resulting in the seed habit, follows the extreme sterilisation of the megasporange which is attained with the organisation of but one megaspore. This was followed by the development of seed-coats, by immediate germination of the "oospore," and by the mature seed-structures. The first retained megaspores were doubtless directly exposed to the microspores; and in *Cordaites* and Cycads a pollen-chamber of varying depth and extent is associated with the early stages of siphonogamy, with which spermatozoid habit was more or less associated. The pollination of Gymnosperms is but a continuation of the ordinary method of dispersing aerial spores employed by Cryptogams; the chief result of the retention of the megaspore upon the male gametophyte being the development of siphonogamy.

Physiological Effect of Plasmolysing Agents.*—From experiments made by M. R. H. True, it results that plants may be fatally affected, both by solutions acting osmotically and by solutions acting through their chemical properties. While many plants suffer when removed suddenly from salt water to fresh, and appear to be dependent on the presence of sodium chloride in the medium, the author states that both sodium chloride and potassium nitrate act as poisons to *Spirogyra*, operating through their chemical properties.

Diseases of Plants.†—The experiments recorded by M. E. Laurent are extremely interesting from a practical as well as a pathological standpoint. The observations were made on various kinds of plants, chiefly potatoes, cultivated on a good soil. The ground was parcelled out into four lots, each lot being treated with a different kind of manure, e.g. sulphate of ammonia, kainite and potash, superphosphate of lime and phosphoric acid, lime. The effect of the following parasitic organisms, *B. coli communis*, *B. fluorescens putidus*, *Phytophthora infestans*, and *Sclerotinia Libertiana*, is discussed at some length. The conclusions arrived at are that *B. coli communis* is a saprophyte, but may become parasitic and acquire virulent properties by culture on alkalised potato, and by subsequent transference to the same kind of tuber. After cultivating on other species, the pathogenic properties disappear. Hence diminished resistance on the part of the host seems to be the starting point from whence the transformation of saprophyte into parasite takes place. The different effect of the same manure on different plants, e.g. phosphate of potash, is explained by the fact that while some microbes require an alkaline medium, to others an acid is more suitable in order to facilitate the action of the microbic diastase, which, by dissolving the intervening vegetable cells, is to prepare the way for the subsequent action of the parasite. Hence the nature of the soil and the composition of the manure greatly influence the resistance of plants to their parasites; and

* Bot. Gazette, xxvi. (1898) pp. 407–16.
† Ann. Inst. Pasteur, xiii. (1899) pp. 1–48.

in order to preserve cultivated lands from the disastrous effects produced by the ever-present microbes, whose destruction it is impossible to prevent, recourse must be had to procedures based on the influence of mineral dressings.

B. CRYPTOGAMIA.

Classification of Cryptogams.*—In the second edition of his *Syllabus der Pflanzenfamilien*, Herr A. Engler includes the Peridinieæ or Dinoflagellatæ as a distinct division, divided into three classes, six orders, and numerous families. In the primary class of EUPHYCEÆ are included the Peridinieæ, Bacillariaceæ (diatoms), Conjugatæ, Chlorophyceæ, Characeæ, Phæophyceæ, Dictyoteæ, and Rhodophyceæ.

Among Gymnosperms, *Gingko* (*Salisburia*), *Rhipidopsis*, *Baiera*, and *Czenakowskia*, are separated from the Taxaceæ, and elevated into a primary class of the same rank as the Cycadeæ and the Coniferæ.

Antherozoids.†—Herr E. Zacharias gives a useful epitome of the results of recent investigations on the structure and mode of origin of the antherozoids in the higher Cryptogamia and in Gymnosperms.

Homology of the Blepharoplast.‡—Mr. C. J. Chamberlain gives a short *résumé* of recent observations on the blepharoplasts in the lower plants, identifying with this organ those variously termed by different writers *Höcker*, *Körnchen*, *Körperchen*, *Nebenkern*, attraction sphere, directive sphere, centrosome, and centrosome-like body. He thinks that the absence of centrosomes from the higher cryptogams and flowering plants is far from being established.

Cryptogamia Vascularia.

Male Prothallium of the Rhizocarpeæ (Hydropterides).§—Herr W. Belajeff has investigated the structure and development of the male prothallium in the four genera *Salvinia*, *Azolla*, *Marsilia*, and *Pilularia*, with a view specially of determining whether, like all the other Archegoniatæ, their antherid has wall-cells. This question he answers in the affirmative; each antherid of *Salvinia*, *Marsilia*, and *Pilularia*, has only one such cell, while that of *Azolla* has two. The structure of the male prothallium exhibits striking resemblances in the four genera. In all of them it breaks up in the first place into three superposed cells or segments. Owing to the position and direction of the first septa, the young prothallium is always dorsiventral. From the lower segment of the male prothallium there is, in all cases, a small lenticular cell cut off. From the middle segment, in *Marsilia*, *Pilularia*, and *Azolla*, first one, and then a second sterile cell is cut off; the remaining section of the middle segment forms the wall-cell or stigmatic cell of the antherid, and the mother-cell of the spermatogenous mass. In the antherid of *Marsilia* and *Pilularia*, the wall-cell undergoes no further division; in *Azolla* it divides into two cells. In *Marsilia* and *Pilularia*, the mother-cell of the spermatogenous mass first divides by a wall which coincides with the plane of symmetry of the prothallium, then

* Syllabus d. Pflanzenfamilien, 2te Ausgabe, Berlin, 1898, 214 pp. See Bull. Bot. Soc. France, xlv. (1898) p. 318. † Bot. Ztg., lvii. (1899) 2te Abth., pp. 1–6.
‡ Bot. Gazette, xxvi. (1898) pp. 431–5.
§ Bot. Ztg., lvi. (1898) pp. 141–94 (2 pls.).

by one at right angles to the first, followed by one at right angles to both the preceding ones. The mother-cell of the spermatogenous mass is thus divided into eight cells, each of which again breaks up into two. The antherid of *Marsilia* and *Pilularia* therefore consists of sixteen spermatogenous and one stigmatic or wall-cell.

Muscineæ.

Regeneration in Mosses.*—In a large number of Mosses, belonging to many different genera, Mr. F. De Forest Heald finds a remarkable power of regeneration in the leaves of all genera, except *Fissidens* and *Ceratodon*; either rhizoids or protonemes being produced; in *Atrichum*, *Polytrichum*, and *Phascum*, from the cells of the ventral side of the leaf; in *Barbula*, *Brachythecium*, and *Funaria*, from special cells of the leaf-base; in *Mnium* and *Bryum*, apparently from all the leaf-cells. The effect of light on regeneration varies in the different genera. The complete separation of the leaf from the stem is necessary for the production of both rhizoids and protonemes. In *Mnium*, buds develop directly on the rhizoids and on the leaves, and in *Fissidens* directly on the stem without the intervention of a protoneme. Protonemes were developed indifferently from any part of the stem; in some cases from axillary cells only; in others from epidermal cells of the internode. The power of moss-leaves to produce protonemes is not destroyed by prolonged desiccation.

Internal Projections in the Rhizoids of Marchantiaceæ.†—Herr L. Lämmermayr finds, especially in cultivated plants of *Fegatella conica*, peculiar projections from the internal walls of the smooth rhizoids, approaching in character those of the peculiar *Zäpfchen-rhizoiden*. In the basal portion of the rhizoids these are sometimes so strongly developed that the cell-cavity is virtually filled up by them. Their chemical nature appears to be the same as that of the *Zäpfchen-rhizoiden*.

Characeæ.

Cell- and Nuclear Division in Chara.‡—Having already determined that no reduction in the number of chromosomes takes place in the formation of the antherozoids in *Chara*, Herr B. Debski now shows that this is also the case in the development of the oosphere in *C. fragilis*. After the absorption of the wall of the nucleus, but before the formation of the spindle, protoplasmic radiations make their appearance around the nuclear cavity. The cell-plate is formed from thickenings of the connecting threads. Peculiar changes take place in the nucleoles and nuclear framework of nearly all the cells, resulting in simple fragmentation of the nucleus; none of these cells undergo further division. In the formation of the spindle, *Chara* presents a closer resemblance to the higher plants than to Algæ. The vacuoles appear to be formed by the increase or coalescence of meshes in the protoplasm. Except in the case of the youngest cells of very active growing points, and of young

* Bot. Gazette, xxvi. (1898) 169–210 (2 pls.).
† Oesterr. Bot. Zeitschr., xlviii. (1898) pp. 321–4 (3 figs.).
‡ Jahrb. f. wiss. Bot, xxxii. (1898) pp. 635–70 (2 pls.). Cf. this Journal, 1897, p. 416.

rhizoids, the cell-wall of *Chara* does not exhibit the reactions of cellulose.

Protoplasmic Currents in the Characeæ.*—Herr G. Hörmann has investigated the effect of various external irritants on the circulation of the protoplasm in *Chara* and *Nitella*. Mechanical irritation produces no effect. Changes of temperature and changes in the concentration of the medium cause a temporary arrest of the motion. A weak electrical current suspends the circulation in the entire cell. In *Nitella* the author believes he has established the existence of a power of active motion of the chlorophyll-grains independently of the protoplasm.

Algæ.

New Genera of Plankton-Algæ.†—Herr E. Lemmermann gives the distinctive characters of a number of plankton-Algæ, all provided with long bristles. They include species—some of them new—of the genera *Golenkinia*, *Richteriella*, *Phythelios*, and *Lagerheimia*, of which fresh diagnoses are given, also the following new genera:—

Franceia g. n. Cellulæ singulæ v. in coloniis consociatæ, libere natantes, tegumentis hyalinis mucosis circumvelatæ, setis longis basi non incrassatis instructæ; chlorophoræ 2–3, parietales; nucleus amylaceus, singulus, sæpe desens; contentus cellularum vacuola singula donatus; propagatio divisione cellularum in unam longitudinalem directionem. Separated from *Golenkinia* and *Phythelios*.

Chodatella g. n. Cellulæ libere natantes, solitariæ v. 2–3 in tegumento cellulari communi dispositæ, ovales v. ellipsoideæ, in utroque fine setis 2–pluribus longis non in tuberculis sedentibus, basi evidenter incrassatis, instructæ; chlorophora singula, parietalis; nucleus amylaceus, singulus; propagatio sporis v. autosporis (2–8); setæ autosporarum post ruptionem cellulæ maternæ evolutæ. Separated from *Golenkinia*, *Lagerheimia*, and *Oocystis*.

Schroederia g. n. Cellulæ singulæ, libere natantes, fusiformes, rectæ v. arcuatæ v. spiraliter contortæ, utroque polo spina instructæ; chlorophora singula, parietalis, granulo amylaceo centrali prædita; propagatio bipartitione cellularum. Separated from *Reinschiella*.

Nucleole and Karyokinesis in Spirogyra.‡—The following are the more important points established by Herr C. van Wisselingh.

The nucleole has a distinct membrane. The most important portion of the contents consists of one or two beautifully coiled nucleolar threads or tubes (*Schläuchen*); if there is only one nucleole in the nucleus, it contains two; if there are two, each nucleole contains one such tube. In *S. crassa* there are two forms of karyokinesis, with and without formation of segments.

In the former case, the larger portion of the framework of the nucleus forms ten necklace-like nuclear threads, which, by contraction, produce ten nuclear segments. The threads become shorter and thicker, and assume the form of tubes with a thick wall. The contents pierce both this

* Studien üb. d. Protoplasmaströmung b. d. Characeen, Jena, 1898, 79 pp., 12 figs. See Bot. Ztg., lvi. (1898) 2te Abth., p. 342.

† Hedwigia, xxxvii. (1898) pp. 303–12 (1 pl., 4 figs.).

‡ Bot. Ztg., lvi. (1898) pp. 195–226 (1 pl.).

wall and the wall of the nucleus, which takes the form of two necklace-like threads; these contract and form two nucleolar segments. The wall and the tube of the nucleole then become absorbed. At the end of each segment a small slender thread appears; they are distinguished from the nuclear segments by their greater resistance to chromic acid. The framework of the nucleus, with its twelve segments, retreats towards the equatorial plane of the nucleus, and forms the nuclear plate. In the process of division of the nuclear plate, a longitudinal fission takes place of the segments and of the resistant threads. The half-segments, twelve in number, coalesce, this process taking place about the same time as the division. The halves of the nuclear plate develop into nuclei, and the halves of the resistant threads into nucleolar threads. If the two nucleolar threads meet, they are surrounded by a common wall, and a nucleole is formed; if they do not meet, each nucleolar thread invests itself wtth a wall, and two nucleoles are formed.

When karyokinesis is not accompanied by the formation of segments, the nucleolar threads become shorter and thicker, and take the form of tubes with a thick wall. The wall of the nucleole then becomes absorbed; the framework of the nucleus retreats to the equatorial plane, and forms the nuclear plate. When the nuclear plate divides, the two resistant threads which lie in the plane of division split longitudinally; but the halves remain for a time united at their ends. The halves of the nuclear plate develop into nuclei, and the halves of the resistant threads into nucleolar threads. Usually the two nucleolar threads are surrounded by a common membrane, and form a nucleole; less often two nucleoles are produced by the formation of a membrane around each thread.

Breaking-up of the Filaments of the Conjugatæ.*—Herr W. Benecke explains the readiness to break up into their individual cells displayed by many Conjugatæ, especially *Mougeotia* and *Spirogyra*, on a purely mechanical principle, quite independent of the action of oxygen. The cells in the filament are only held together by the cuticle; the septa are split at an early period into two lamellæ. The breaking up of the filament is the result either of a uniform increase in turgor of all the cells, or, more often, of the loss of turgor in particular cells. Dead or injured cells are in this way thrown off; and probably the same process facilitates the separation of conjugated cells from the rest of the filament.

Diatom Structure.†—Mr. E. M. Nelson describes a variation in *Coscinodiscus Asteromphalus*, in which, instead of the well-known pattern consisting of a ring of larger areolations surrounding the finely perforated membrane which covers a large polygonal cell, we have a circular ring of brackets projecting inwards to strengthen this delicate membrane or cover.

He also records the interesting discovery, in a specimen of the same diatom of the common form, of a tertiary structure which he believes to be a stage in the evolution of the central perforated membrane. He adduces reasons for regarding the following as an enumeration of the

* Jahrb. f. wiss. Bot., xxxii. (1898) pp. 453–77 (1 fig.).
† Journ. Quekett Micr. Club, vii. (1898) pp. 81–7 (1 pl.).

steps in the evolution of this species:—(1) A small equilateral triangle is formed at the intercostal junction of the polygonal cells. (2) The angles of the triangle become blunted. (3) The blunted end becomes notched. (4) The notches deepen, and eventually becoming circular, form a perforation at each intercostal angle. At the same time the sides of the triangles form a larger perforation between them. These larger perforations are situated at the bisection of the sides of the hexagon. (5) The peripheral perforations situated at the intercostal angles break up into two, and, by repeated subdivisions, form the central finely perforated membrane. (6) The peripheral perforations, when the central membrane is complete, become more or less of a uniform size, and then break up into tertiaries. (7) Repetitions of the 6th process produce a uniform and delicate perforated membrane over the whole of the valve. The 7th stage is conjectural only; and, if the author's view of the evolution is correct, the ordinary *Asteromphalus* form is but an intermediate stage in the full development of this diatom.

Siliceous Valve of Diatoms.—Mr. F. J. Keeley, of Philadelphia, sends us some diatom photographs, with a description of the mode of preparation, and the results obtained.

After some rather unsatisfactory experiments in imbedding diatoms with the view of grinding sections similar to those prepared from natural cement-stones, the idea presented itself to Mr. Keeley that if he mounted broken valves with their edges in contact with the cover-glass and at right angles to it, and examined them with objective and condenser of large aperture, an optical section would result, of equal value to a true section, and having the advantage over the latter, if ground after imbedding, of certainty as to the identity of the form and freedom from interference of the imbedding medium. This proved to be the case; and some years ago he applied the method to a number of species, and communicated the results obtained to the Academy of Natural Sciences of Philadelphia, but had neglected to write up the paper for publication. The diatoms of which photographs were sent are *Coscinodiscus Asteromphalus* Ehr., *Actinoptychus heliopelta* Gr., and *Aulacodiscus Sollittianus* Norm. from Nottingham, Md., and *Triceratium grande* Brightw. and *Auliscus Oamaruensis* Gr. and St. from Oamaru, N.Z.—species which show the typical structure of their respective genera to good advantage. The last species in particular shows a remarkable tubular structure in the comparatively thick plate of the valve.

It is unnecessary to go into details as to conclusions, as the section-views obtained seem to admit of but one interpretation. In comparing other species examined with those included in the slide, *Coscinodiscus Asteromphalus* seems to fairly typify the genus, a middle honeycomb-like layer, with external plate containing symmetrical groups of apertures in each alveole and internal plate with but one aperture, having thickened margin, in each alveole, forming the "eye-spot."

The *Triceratia* (or *Biddulphiæ*) of the *favus* type have a similar middle cellular layer, but the finer perforations are in the internal plate, and are arranged symmetrically with the centre of the valve. The outer plate contains holes almost as large as the "honeycomb" cells. *Triceratium arcticum* and the numerous species of similar character found at Sendai, closely resemble *Coscinodiscus* in structure, the finer perforations being in the external plate. Another class of *Triceratia*, including *T. majus*, seem to consist of but one plate strengthened by costæ and pierced at rather wide intervals.

Auliscus seems to consist of but a single plate with tubular perforations; as also do those species of *Actinoptychus* which do not show the coarser reticulations. Where the latter are present, they might be regarded as analogous to the "honeycomb" layer of *Coscinodiscus* or *Triceratium*, being evidently raised above the general surface. The inner plates, which can frequently be removed from valves of this genus, are not regarded as corresponding to the inner plates of areolated form, but merely as thin reproductions of the valve.

Many species of *Aulacodiscus* resemble *A. Sollittianus* in structure; but another class, such as *A. Rogersii*, have a radically different structure, which, owing to their being very opaque when viewed on edge, Mr. Keeley has so far been unable to satisfaciorily elucidate.

With regard to the film of silica presumed by some microscopists to exist over the entire surface of living diatoms, and destroyed by cleaning, a careful study of living forms, action of stains, &c., has failed to show any evidence of its existence.

Fungi.

Penetration of Fungi into Calcareous Rocks and Bones.* — According to experiments made by Herr K. Lind, the penetration of fungi and bacteria into rocks is largely due to a chemical irritation. If a thin plate of chalk, marble, or bone is moistened on one side by a nutrient fluid, and the spores of fungi sown on the other side, the fungi will perforate the plate; while, if the spores are sown on the side moistened with the nutrient fluid, or if both sides are moistened, no perforation will take place. Many fungi also secrete considerable quantities of carbonic and oxalic acids, which have a powerful effect in corroding limestone. Of the three fungi chiefly experimented on, *Botrytis cinerea* displayed the greatest power of corrosion, next *Penicillium glaucum*, and lastly *Aspergillus niger*. The author points out the importance of these observations in practical dentistry.

Effect of Aqueous Solutions on the Germination of Fungus Spores.†—As the result of a long series of experiments on different fungi, Mr. F. L. Stevens states that various fungi offer very different resistance to poisons, and that the limits of resistance vary in the same species. In general the results are in accord with the theory of hydrolytic dissociation. *Uromyces* offers the greatest range in its susceptibility to poisons; while *Penicillium* offers the greatest resistance. Peculiar knotted or twisted hyphæ frequently result from the attempt to grow in a poisonous solution.

Monograph of the Peronosporaceæ.‡—In the present instalment of his account of the Peronosporaceæ, Prof. A. N. Berlese gives a description of the different modes of fertilisation that occur in the family. The sexual act does not consist in an osmotic diffusion, as suggested by de

* Jahrb. f. wiss. Bot., xxxii. (1898) pp. 604–34 (3 figs.).
† Bot. Gazette, xxvi. (1898) pp. 377–406 (1 fig.).
‡ Riv. Patol. Veg., vii. (1898) pp. 19–37. Cf. this Journal, 1898, p. 657.

Bary, but in an actual fusion of male and female nuclei. The mode of life of the parasites, and the influence exerted on the host-plants, are described in detail.

Classification of Mucorini.*—Mr. Pound proposes the arrangement of the American Mucorini under 5 groups as follows:—1. Mucoreæ (Eumucoreæ, Rhizopeæ, Thamnidieæ, Piloboleæ); 2. Mortierelleæ (*Mortierella*, *Herpocladium*, *Carnoya*); 3. Choanephoreæ (*Choanephora*); 4. Chætocladieæ (*Chætocladium*); 5. Cephalideæ (*Piptocephalis*, *Syncephalis*, *Syncephalastrum*).

Natural Dissemination of Wine-Yeasts.†—M. L. Boutroux records an experiment made in 1884, the results of which favour the views of Berlese as to the dissemination of ferments. He took 116 tubes, and into these put untouched quite ripe grapes, and into 32 tubes were placed grapes which had been soiled by insects. Into each tube pure wine must was passed, and the tubes incubated at 30°. Of the 32 tubes containing grapes contaminated by insects, 30 fermented, and the remaining two were found to contain *Saccharomyces*. Of the 116 tubes only one fermented. Examination showed that in most cases the ferment was *S. apiculatus*, but the single instance among the 116 untouched grapes was found to be a true wine ferment. Hence it seems more probable that wine-yeasts are disseminated by insects than by the air; and this explanation also takes into account the sudden appearance of wine ferments at the time when the grapes are ripe.

Germinating Power of the Winter-spores of Uredineæ.‡—Prof. J. Eriksson states that, in the case of the Uredineæ submitted to investigation—species of *Puccinia*, chiefly *P. coronata* and *graminis*—the hibernating spores are capable of germinating only in the spring immediately following the autumn in which they are produced.

Fungi of Ambergris.§—M. H. Beauregard gives a detailed account of the fungi found in ambergris; among the most frequent of which is one belonging to the Mucedineæ, to which he gives the name *Sterigmatocystis ambari* sp. n.; it is a polymorphic species. Among the Schizomycetes is a new species of *Spirillum*, named *S. recti Physeteris*, resembling *B. coli commune*, but not displaying the indol reaction, and destitute of the power of producing lactic fermentation. It liquefies gelatin, but only at the point of inoculation. It was cultivated easily on bouillon-peptone. It is readily stained, but not by Gram's method.

Fungi of Rotten Fruit.‖—Dr. J. Behrens has investigated the mould fungi which cause the rotting of fruit—apples, pears, plums, cherries, apricots, currants, grapes, tomatoes, walnuts, &c.—and finds them to be *Penicillium glaucum*, *P. luteum*, *Mucor stolonifer*, *Botrytis vulgaris*, and *Oidium fructigenum*. The *Botrytis* differs from the others in attacking all parts of the plant, producing a poison which is fatal to living proto-

* Minnesota Bot. Studies, ix. (1894) p. 87. See Bonnier's Rev. Gén. de Bot., x. (1898) p. 490.

† Comptes Rendus, cxxvii. (1898) pp. 1033–6. Cf. this Journal, 1898, pp. 112, 572.

‡ Centralbl. Bakt. u. Par., 2te Abth., iv. (1898) pp. 376–88, 427–32.

§ Ann. de Micrographie, x. (1898) pp. 241–78 (1 pl.).

‖ Centralbl. Bakt. u. Par., 2te Abth., iv. (1898) pp. 514–22, 547–53, 577–85, 635–44, 700–6, 739–46, 770–7.

plasm. The author enters into great detail respecting the injuries produced by these parasitic fungi, and the best preventives and remedies.

The Symbiotic Mycoplasm Theory.*—Mr. H. L. Bolley contests the theory of Eriksson that the Uredineæ carry on a kind of symbiotic existence in the tissues of the host-plant. He believes them to be true parasites. His observations also lead to the conclusion that the parasite enters the host-plant, not through the stomates only, but also directly through the cuticle. He was quite unable to find, in the cells of the host-plant, the "mycoplasm" particles which Eriksson regards as the latent condition of the parasite.

Fungus in the Ovary of Darnel.—M. P. Guérin † has detected, in the seeds of *Lolium temulentum*, the constant presence of a Fungus-mycele, to which he attributes the production of the poisonous principle (temulin) which they contain. It is found in the external layers belonging to the nucellus beneath the integument. The hyphæ are abundantly septated; but there is not sufficient evidence to determine the systematic position of the fungus. It was found also in other species which have a poisonous reputation, *L. arvense* and *linicola*, but not in *L. italicum*. Its mode of life is probably symbiotic rather than parasitic.

Herr T. F. Hanausek ‡ describes a similar fungus mycele, apparently always sterile, in the ripe seeds of *Lolium temulentum*, but not in those of *L. perenne*. It appears to have no injurious effect on the development or fertility of the seed.

In *L. temulentum*, but not in any other species of *Lolium*, a similar phenomenon is described by Dr. A. Nestler,§ who also suggests this as the cause of the poisonous properties of darnel.

Nuclear Division in the Basids of the Basidiomycetes.‖—From an examination of the mode of division of the nucleus in the basids of a large number of Basidiomycetes, Herr H. O. Juel has come to the conclusion that all basids are identical structures from a morphological point of view, and have a common origin. This view is based on the fact that their "internal morphology"—i.e. the processes of nuclear and cell-division—present a much greater uniformity in the various types than their external morphology.

The nucleus of young basids always arises from the coalescence of two original nuclei; but the author does not regard this as a process of sexual union. After this coalescence, the nucleus always breaks up, by two successive karyokineses, into four daughter-nuclei, which produce the four basidiospores. In *Dacryomyces*, where only two spores are formed, two nuclei remain behind in the sterigmas.

According to the position of the spindle in the process of nuclear division, whether longitudinal or transverse, the author divides the

* Centralbl. Bakt. u. Par., 2te Abth., iv. (1898) pp. 855–9, 887–96, 913–9 (6 figs.). Cf. this Journal, 1897, p. 232.

† Journ. de Bot. (Morot), xii. (1898) pp. 230–8, 384–5 (5 figs.).

‡ Ber. Deutsch. Bot. Ges., xvi. (1898) pp. 203–7 (4 figs.).

§ Tom. cit., pp. 207–14 (1 pl.).

‖ Jahrb. f. wiss. Bot., xxxii. (1898) pp. 361–88 (1 pl.).

Basidiomycetes into two primary groups, the Stichobasidieæ and the Chiastobasidieæ. The former is probably the original arrangement; and the Uredineæ may be regarded as the primary form of Basidiomycetes; from them have sprung the Coleosporieæ, Auriculineæ, Dacryomycetes, and Tulostomineæ. The lowest group of the Chiastobasidieæ are the Tremellineæ, from which are derived the Tulasnellineæ and the Hymenomycetes.

Spores of Hymenomycetes.*—Dr. M. Lanzi discusses the value of the characters derived from the spores of the Hymenomycetes for the purposes of classification and diagnosis. Of these he finds the most constant to be those belonging to the form and colour, though the apparent form often varies according to the aspect in which the spore is viewed. Characters derived from the size of the spores are not so reliable, though they can be used within certain limits. In the same individual the size of the spores often varies according to their position on the hymenium.

Rabenhorst's Cryptogamic Flora of Germany (Fungi Imperfecti).†—The two most recently published parts of this work complete the genus *Phoma*, of which the total number of species described is 574. *Macrophoma* is then disposed of, with 80 species, and the genus *Aposphæria* described, with (so far) 12 species.

Staining Protoplasm with the Pigments of Fungi.‡—M. L. Matruchot has, by cultivating simultaneously a *Fusarium* and a *Mortierella* on the same medium, succeeded in staining the protoplasm of the latter with the pigment of the former which had become diffused in the nutritive substratum. The author quotes other examples, such as the staining of *Mucor racemosus* with the pigment of *Penicillium*; of the staining of uncoloured parts of a fungus with the pigment of the coloured parts, e.g. *Monascus purpureus*, *Eurotiopsis Gayoni*, and *E. Saussinei*.

This natural staining may be used for investigating the structure of living organisms.

Blastomycetes and Carcinoma.§—Dr. D. B. Roncali describes a case of adeno-carcinoma of the transverse colon (papilloma infectans), in which he found *Blastomyces vitrosimile degenerans.* Pure cultures injected into guinea-pigs caused death in 15–30 days. Deposits were found in various tissues and organs. These deposits presented the appearance of granulomata, but with characters more akin to those found in malignant neoplasms than in inflammatory deposits.

Pathogenic Action of Blastomycetes.‖—Dr. M. P. Nesczadimenko made a series of experiments on mice, rats, rabbits, guinea-pigs, and dogs, for the purpose of testing the pathogenic action of Blastomycetes. Cultures were injected into the peritoneal sac. The animals died in from 8–12 days. In rats and guinea-pigs, besides a fibrinous inflammation, there were small nodules on the peritoneum. These nodules were composed of leucocytes, round cells, and Blastomycetes. Cultivations

* Atti Accad. Pontif. Nuovi Lincei, li. (1898) pp. 61–4.
† Lief. 63, 64. Cf. this Journal, 1898, p. 660.
‡ Comptes Rendus, cxxvii. (1898) pp. 881–4.
§ Centralbl. Bakt. u. Par., 1te Abt., xxiv. (1898) pp. 61–9, 158–65, 212–34, 306–15, 353–9 (2 pls.).
‖ Op. cit., xxv. (1899) pp. 55–8 (1 fig.).

from the organs indicated the existence of a general saccharomycosis. Subcutaneous injections resulted in a saccharomycosis with the formation of abscesses, the walls of which were formed of young connective tissue, fibroblasts, and giant cells.

The Blastomycetes in the tissues were demonstrated by means of hæmatoxylin, eosin, and Bismarck-brown.

New Experiments on Spore-formation in Saccharomycetes.*—By cultivating on the following media :—(1) pepton 1 per cent., dextrose 5 per cent., potassium phosphate 0·3 per cent., magnesium sulphate 0·2 per cent.; (2) pepton 1 per cent., maltose 5 per cent., potassium phosphate 0·3 per cent., magnesium sulphate 0·5 per cent.; (3) beerwort, *Saccharomyces cerevisiæ* i., *Sacch. Pasteur* i., and Johannisberg ii., Prof. E. C. Hansen found that the growth in all three fluids was quite alike, and that the different chemical composition of the medium had in this case at least no influence on the maximum temperature for spore-formation.

Vaccinating Properties of Mushroom-juice against Venom.†—M. C. Phisalix has found that mushrooms contain substances having vaccinating properties against serpent venom. Some two hundred experiments made with poisonous and edible mushrooms show that their juice, which contains these bodies in solution, confers immunity against venom. Injection (subcutaneous, intraperitoneal, and intravenous) of small doses of the juice of *Agaricus arvensis* produces local and general reaction; of large doses, rapid death, with clotting of the blood. The toxic effects of the juice, even when heated for 20 minutes to 120°, are not completely removed.

When a guinea-pig has been injected with 5–20 ccm. of the juice, after a few days it will resist a dose of venom fatal in 5–6 hours to the controls. This immunity may be augmented to a certain degree by increasing the number of inoculations. The immunity thus acquired lasts 15 days to a month.

The raw juice often produces necrotic effects; these are lessened by using filtered juice, and are avoided by boiling it for a few minutes. This, so far from impairing the vaccinating property, rather seems to favour it.

Protophyta.

β. Schizomycetes.

Crenothrix Kühniana.‡—Sig. G. Gasperini enters, in great detail, into the life-history of this organism, and the causes of its injurious effects on drinking water. The species is identified with Cohn's *C. polyspora*; and the author sinks the genus in *Beggiatoa*, of which it is merely a growth-form. The organism may occur in four different forms :—A zooglœa or palmella form; in the forms of septated and of non-septated filaments; and in a moniliform condition. *Crenothrix* may be regarded as a form of *Beggiatoa* capable of forming an ochraceous sheath in ferruginous waters.

* Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 1–6.
† Comptes Rendus, cxxvii. (1898) pp. 1036–8..
‡ Atti Soc. Tosc. Sci. Nat., xvi. (1898) pp. 240–359 (2 pls.).

Bacterial Disease of Sweet-corn.*—Mr. F. C. Stewart finds, on sweet-corn in Long Island, a disease different from that already known on Indian corn produced by a bacillus. It is caused by a bacterium (unnamed) with the following characters:—Cells short, motile, with rounded ends, occurring commonly in pairs; each pair about 2·5–3·3 × 0·65–0·85 μ; no spores were found.

Spore-formation and Germination as Diagnostic Criteria of Species.†—Herr G. Burchhard, in a contribution to the morphology and development of bacteria, compares the spore-formation and germination of a large number of species, and comes to the following important conclusions:—(1) Spore-germination for each species of bacterium is characteristic and invariable. (2) Hence spore-germination is the safest diagnostic criterion for the recognition of a species. (3) In addition to polar and equatorial germination, there is also an oblique one (*B. loxosus*). (4) There are bacteria with regular bipolar germination (*B. bipolaris*). (5) There is a polar germination with equatorial rupture of the spore-membrane (*B. idosus*). (6) There are bacteria which possess two spore-membranes (*Bact. Petroselini*). (7) In many species the position of the spore is, within certain limits, a variable one (*Bact. perittomaticum*, *Bact. brachysporum*, *Bact. filamentosum*, *Bact. paucicutis*, *Bact. Armoraciæ*). (8) In rare cases the spores are of unequal length (*B. goniosporus*). (9) The shape and size of the spore is dependent on the nature of the nutrient medium and the age of the culture. (10) The spore does not alway lie in the long axis of the bacterium (*B. loxosus*). (11) As the spore ripens, the mother-cell may undergo a complete change of shape (*Bact. angulare*).

Thermophilous Bacteria.‡—Herr A. Schillinger instituted some experiments on the fermentive power of thermophilous bacteria, by inoculating sterile milk with earth and incubating at 66° C. The milk coagulated in 24 hours, and in 24 hours more there was copious gas formation, which lasted for 5–6 days. In grape and milk-sugar bouillon impregnated with earth, there arose copious gas formation at 66° after 24 hours, but in unsaccharated bouillon only a scanty production. Four species of thermophilous bacteria were isolated from different samples of earth; three of these coagulated and fermented milk at 37°, while the fourth acted on grape and milk-sugar, and on starch. These characteristics were, however, not verified at 66°. The designation of thermotolerant in lieu of thermophilous is suggested for these bacteria, in view of the fact that 66° is not proved to be the optimum.

Acetifying Bacteria.§—M. D. P. Hoyer, in a lengthy article, discusses many of the characteristics of acetic acid bacteria. The study is divided into four parts. In the first are described the species and varieties of acetic acid bacteria, while the remaining three are devoted to respiration and nutrition, zymotic nutriment, and oxidation of various substances. For the details the original should be consulted. The

* Bull. Soc. New York Agric. Exp. Stat., 1897, pp. 423–39 (4 pls.). See Bot. Centralbl., lxxvi. (1898) p. 316.

† Klein and Migula, Arb. a. d. Bacteriol. Inst. zu Karlsruhe, ii. pp. 1–64 (2 pls.). See Beibl. z. Hedwigia, xxxvii. (1898) pp. (213)–(214).

‡ Hygien. Rundschau, 1898, p. 568. See Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 925–6.

§ Arch. Néerland. Sci. exact. et nat., ii. (1899) pp. 190–240.

results were that *B. aceti* and *B. xylinum* are distinguished from *B. rancens* and *B. pasteurianum* by their power of inverting cane-sugar. Malic, citric, and hydrochloric acids were found to affect profoundly the shape of beer vinegar bacteria. Acetifying bacteria may retain their vitality in the absence of air; and they then reduce indigo-blue, methylen-blue, and litmus. The development of these bacteria is always accompanied by disengagement of carbonic anhydride. The nutrition of these organisms may be divided into genetic nutrition, which determines growth and cell-division, and zymotic nutrition, which is not necessarily accompanied by growth. The elements indispensable to genetic nutrition are C, H, O, N, K, Mg, and P. Nitrogen may be derived from pepton, asparagin, nitrites, or ammonia salts, the carbon from acetic acid, acetate of sodium, lactate of lime, and, in the case of *B. aceti* and *B. xylinum*, from cane-sugar. The assimilation of certain nitrogenised substances is determined by the nature of the carbon-nutriment. In addition to substances already known, the following may serve for zymotic nutrition: lactic, succinic, citric, malic, and gluconic acids, lactate, acetate, and propionate of calcium. Tartaric acid is not attacked by acetifying bacteria. Quantities of alcohol and of acetic acid compatible with growth have no action on the acetifying function. Below 4 per cent. alcohol does not influence development, above 4 per cent. it retards it, while near 9 per cent. there is no longer any development. Acetic acid retards the growth, development diminishing in proportion to the increase of acid.

Species of Acetic Acid Bacteria.*—Herr M. W. Beijerinck recognises four chief species of acetic acid bacteria:—(1) *Bacterium aceti* Pasteur, the quick acetic acid bacteria; (2) *B. rancens* sp. n., beer acetic acid bacteria, including cultivated and wild varieties; (3) *B. Pasteurianum* Hansen, beer acetic acid bacteria which stain blue with iodo-potassic iodide; (4) *B. xylinum* Brown, bacteria which are detrimental to the acetic acid in vinegar, and form viscid and even cartilage-like membranes on saccharated media. Around these four chief species are grouped other varieties respecting which more information is promised later.

With regard to *B. aceti* and *B. rancens*, the interesting fact is mentioned that the former can derive its nitrogen directly from ammonia salt, while the latter cannot. *B. aceti* forms a vinegar scum on the following fluid medium:—alcohol 3 per cent., ammonium phosphate 0·05, calcium chloride 0·01, tap-water 100.

Micro-organisms in Flour.†—Mr. C. G. Ferris has examined from a bacteriological standpoint numerous samples of flours, and his figures show beyond a doubt that the high grade patent flours are much freer from bacteria than the medium and common grade products, while the number of moulds found in these flours does not vary to the appreciable extent that the bacteria do. Seventeen species of bacteria, one yeast, and three moulds were found. One bacterium appears to be new. The colonies are white, dry, and tough. On removing the growth, a brown substratum is revealed. This organism grows readily on agar, wort-gelatin, blood-serum, starch and flour pastes. Gelatin is liquefied. The

* Handelingen 5[en] Nederlandsch Natuur- en Geneeskundig Congress, 1897, p. 263; also Centralbl. Bakt. u. Par., 2[te] Abt., iv. (1898) pp. 209-16.

† Proc. Indiana Acad. Sci., 1897, pp. 137-40.

bacterium is a potential anaerobic bacillus, devoid of movement, about $1 \times 1 \cdot 7\ \mu$. In old cultures there is a distinct odour of hay. Cultures of starch and flour paste give the sugar reaction.

Two New Hailstone Microbes.*—Mr. F. C. Harrison describes two new species of bacteria, isolated from hailstones which fell in 1897.

Bacillus flavus grandinis is $1 \times 3\ \mu$ in size, has rounded ends, and occurs singly or in pairs. It is non-motile, does not form spores, stains readily, and does not liquefy gelatin. It is aerobic; grows well at 20°; the colour of the growth on the usual nutrient media, including Uschinsky's, being yellow.

Micrococcus melleus grandinis is a coccus about $1\ \mu$ in diameter; grows well at 20°; is aerobic; stains readily. It does not liquefy gelatin; and grows well in most of the usual media, the colour of the growth being yellow.

Micro-organism of Faulty Rum.†—In their monograph on "faulty rum," Mr. V. H. Veley and L. J. Veley give an interesting description of a micro-organism, designated *Coleothrix methystes*, which has the faculty of existing in very strong alcohol (nearly 75 per cent.) Faulty rum is recognised by the turbidity and deposit which occur after admixture with water in amount sufficient to reduce its alcoholic strength to 25 per cent. under proof. Previous to the researches of the writers, faultiness of rum was ascribed to the presence of a resin extracted by the alcohol from the cask-wood, or to the presence of certain salts in the water used for testing the rum. The "turbidity" of the fluid is shown by the authors to be partly a turbidity properly so-called, i.e. due to the presence of suspended demonstrable particles, and partly a fluorescence due to the fact that the organism extracts and assimilates that particular ingredient of the caramel which is fluorescent.

Microscopical examination of the sediment showed cocci occurring in pairs, groups, singly, and in chains. The cocci were yellowish in colour and surrounded by a thick highly refractive colourless envelope. In diameter they varied from 1–5 μ.

Cultivations were made in various media, and three forms, coccus, bacillus, and filament, were observed. From this coalition the authors infer that *Coleothrix methystes* is a polymorphic organism belonging to the higher bacteria, and probably allied to the *Streptothrix* group. The organism is preferentially aerobic, but potentially anaerobic; direct sunlight appears to favour its growth; it is not pathogenic to animals; it produces acid, and reduces nitrates to ammonia. Under certain circumstances it produces a colouring matter having a yellow or reddish-yellow hue with green fluorescence.

It would be difficult to overestimate the value of the observations recorded in this monograph, or the methods employed in the careful investigation, and the authors are to be congratulated on being the first to show that life can exist in alcohol of nearly 75 per cent. strength.

Histology and Bacteriology of the Oyster.‡—The primary object of Prof. W. A. Herdman and Prof. R. Boyce was to study the oyster

* Bot. Gazette, xxvi. (1898) pp. 211–4.
† London (Henry Frowde), 1898, 64 pp., 7 pls.
‡ Proc. Roy. Soc., lxiv. (1899) pp. 239–41.

under unhealthy conditions, in order to elucidate its supposed connection with infective diseases. The general inference from their observations seems to be that when oysters are removed from their natural environment they are more or less easily infected, and that clean and fresh sea-water is inimical to pathogenic organisms (*B. typhosus*) The coli group of bacilli was frequently found in shell-fish as sold in towns, and especially in the oyster, and also an anaerobic spore-bearing bacillus having the characters of *B. enteritidis sporogenes.*

The authors include in their research, work on the normal histology of the oyster, and on the vexed question of the greening of oysters. Greening may be due to a leucocytosis associated with the presence of a greatly increased amount of copper, or may depend upon the presence of a special pigment, "marennin."

Leucocytes and Arsenic Intoxication.*—Dr. Besredka, in a first memoir on immunity to arsenic compounds, deals with the part played by leucocytes in the intoxication produced by trisulphide of arsenic. The injection of trisulphide solution into the peritoneal sac of guinea-pigs is immediately followed by hypoleucocytosis. The subsequent phenomena are determined by the amount of the poison. If the dose be a fatal one, there is negative chemiotaxis, and little or no phagocytosis; while the survival of the animal is marked by positive chemiotaxis and by intense phagocytosis. The phagocytosis is not, however, merely confined to englobement and chemiotaxis, for the trisulphide is digested, and is transformed into a soluble compound which is excreted by the kidneys.

Persistence of Bacteria in the Cow's Udder.†—Mr. A. R. Ward, in the course of experiments relative to the persistence of bacteria on the milk-ducts of the cow's udder, found that the cistern could be temporarily colonised with *B. prodigiosus*, for this microbe was detected in cultivations from the milk for six days after. The author's experiments also show that bacteria may exist in the udder for a considerable length of time, and that although they can usually be demonstrated in the milk, this may not always be the case. These observations support the view that the last drawn milk is not necessarily sterile.

Importance of Intestinal Bacteria in Nutrition.‡—For his experiments as to the importance of intestinal bacteria in nutrition, Herr M. Schottelius made use of chickens hatched under sterile conditions. Though the idea is in itself perfectly simple, the details of the procedure adopted were extremely complicated, and difficult to be carried out in practice. For these the original should be consulted. The experiments showed that fowls brought up under perfectly sterile conditions gained little in weight or size, the maximum increase in 12 days being only about 25 per cent. After 12 days there was, if anything, a decrease. Fowls brought up under ordinary conditions increase by the 12th day by 140 per cent., and by the 17th by 250 per cent. It therefore follows that in the case of chickens, at least, bacteria are very useful for digestive work. Cultivations made from the excrement proved devoid of

* Ann. Inst. Pasteur, xiii. (1899) pp. 49–66.
† Journ. Applied Microscopy, i. (1898) pp. 205–9 (1 fig.).
‡ Arch. f. Hygiene, xxxiv. (1899). See Ann. Inst. Pasteur, xiii. (1899) pp. 77–80.

bacteria, and for the first 4 to 8 days, of diastase. Later on, however, the medium was liquefied, bacteria being still absent. These facts indicate the utility of the bacterial secretions in assisting digestion; and this view is confirmed by the absence of microbes in the dejecta of fowls brought up in the ordinary way during the first 36 or 40 hours; for during this period they scarcely increase in weight.

Number of Micro-organisms in Air, Water, and Milk, as determined by their Growth in Different Media.*—Mr. A. W. Bitting shows, by experiments made with agar, glycerin-agar, beef-gelatin, and wort-gelatin, that the number of organisms in air, water, and milk vary with the medium, agar showing the highest number of bacteria, and wort-gelatin the highest number of moulds. Hence it is important to indicate the medium used, and how it is prepared, as well as the number of microbes found.

Necessity of Xylose to Denitrifying Bacteria.†—In a preliminary communication, Prof. J. Stoklasa states that he regards pentose xylose, $C_5H_{10}O_5$, which is derived by hydrolysis from pentosan xylan, as the most suitable and most natural nutriment for denitrifying bacteria. This conclusion was arrived at from observing that denitrification was greatest in media containing xylose, as contrasted with arabinose, glucose, fructose, and saccharose. The denitrifying bacteria used were *Bacillus megatherium* (*B. Ellenbachii a*), *B. denitrificans*, *B. subtilis*, and *B. fluorescens liquefaciens*.

The Bacterial Capsule.‡—Dr. R. Binaghi records his endeavours to demonstrate a capsule in streptococci derived from six different sources. No trace of a capsule was discoverable in any of the instances. After referring to *Str. capsulatus*, the author alludes to 28 capsule bacilli, the enumeration of which may be found useful to those interested in the subject. He concludes from his observations that (1) as a rule, streptococci are devoid of capsules; (2) that when bacteria are provided with a capsule, this is always to be found in the natural medium, and frequently in artificial; (3) the capsule is to be regarded as the swollen outer layer of the bacterial membrane which comes into existence owing to the biochemical activity of the bacterium within the organism.

Capsule Bacilli and their Differentiation.§—Dr. L. W. Strong thus summarises the distinction between two groups of capsule bacilli. In the first, or Friedländer group, are included *B. pneumoniæ* Friedländer, *B. ozænæ* Fasching, *B. sputigenus crassus* or *mucosus capsulatus*, *B. Wright and Mallory*, and perhaps *B. rhinoscleromæ*.

The young colonies are colourless, but become white with age. The capsules of the organisms taken from the animal body are easily stained; on artificial media there are only pseudo-capsules. Gas formation is very copious when the medium contains cane-sugar, less so with grape-sugar, and little or not at all with milk-sugar. There is no formation of acid in milk-sugar bouillon, and milk is not coagulated.

* Proc. Indiana Acad. Sci., 1897, pp. 143–4.
† Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 817–9.
‡ Tom. cit., pp. 897–902, 919–24. Cf. this Journal, 1897, p. 577.
§ Op. cit., 1te Abt., xxv. (1899) pp. 49–52.

The second or Aerogenes group contains *B. aerogenes* Escherich, *B. Pfeiffer*, and *B. capsulatus* Kruse. The colonies are whitish from the first. Even in the animal body the capsules are hard to stain, and there are no pseudo-capsules in artificial cultures. With all three kinds of sugar there is copious and constant gas formation. Acid is formed in all three kinds of sugar-bouillon. Milk is rapidly coagulated.

Bacillus coli capsulatus.*—Dr. L. Jenner describes an organism which is remarkable for its pathogenic properties when possessing a capsule; but when the capsule is absent it is little or not at all virulent. *B. coli capsulatus* is a rodlet with rounded ends, of variable length, but usually short. It grows well on various media. It does not liquefy gelatin. It develops gas in gelatin shake cultures, and on saccharated media. It coagulates milk, forms indol, and produces acid. It stains with anilin dyes, but not by Gram's method. The capsules are demonstrable by staining first with phenol-fuchsin, and afterwards with aqueous gentian-violet; by this method the body of the bacterium is stained red and the edge of the capsule violet. A non-capsulated form of the organism is obtained from cultures of old smears on gelatin, by inoculating the latter in pepton water, and incubating the tubes at 37° for 24 to 48 hours, and making secondary gelatin smears from them.

The results obtained from inoculating animals with capsuled and non-capsuled cultures are strikingly different. The capsuled forms are fatal to white mice in a few hours, while the non-capsuled variety is little if at all fatal. It would, therefore, seem that the capsules are to be regarded as protective.

Colonies of the capsuled form are sharply delimited; when the growth is mixed, i.e. containing more or less of the non-capsuled variety, the margins of the colonies become more or less irregular and crenated.

Pathology of Venous Thrombosis.†—Dr. M. Jakowski shows that the natural toxins, freshly produced by bacteria, introduced into the blood current, are far more powerful exciting causes of venous thrombosis than the artificial toxins, made from cultures of the same bacterium, injected into the circulation. The experiments were made on guinea-pigs, with *B. coli com.* and its toxins.

Diplococcus magnus.‡—Dr. A. G. Rosenthal, in a preliminary account, gives a description of a coccus, *Diplococcus magnus*, found in the air. It is of large size, has a distinct capsule, is almost invariably in pairs, and is kidney-shaped. It does not stain by Gram's method. It was cultivated on the usual media, and grew best at 37° C.

Resistance of Diplococcus lanceolatus to Drying.§—According to Dr. D. Ottolenghi, *Diplococcus lanceolatus* retains its virulence in dried sputum for more than 70 days, while its vitality may persist even after its virulence has been extinguished.

* Journ. Pathol. and Bacteriol., v. (1898) pp. 257–61 (1 pl.).
† Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 10–12, 58–64.
‡ Tom. cit., pp. 1–4 (3 figs.). § Tom. cit., pp. 120–1.

Action of Bacillus coli and Bacillus typhosus on Nitrates.*—M. L. Grimbert, who had previously found that *B. coli* and *B. typhosus* do not set free nitrogen when cultivated in a 1 per cent. solution of nitrated pepton, but do so in peptonised bouillon, made experiments to ascertain the reason of this difference of action and in the origin of the produced nitrogen. The results were that each time the *B. coli* or *B. typhosus* produced gas in a nitrated medium, the volume of gas collected was always at least double of that which corresponded to the destroyed nitrate. Consequently the nitrogen set free was not exclusively derived from the nitrates. The denitrifying action of these bacilli is associated with the presence of amide substances in the culture, and appears to result from the secondary action which the nitrous acid produced by the bacteria exerts. Nitrites do not fetter the action of these bacilli.

Atlas of Bacteriology.†—The Atlas of Bacteriology by Messrs. C. Slater and E. J. Spitta will be found to be a useful work of reference by students, especially those engaged in laboratory work. The volume is illustrated by 111 original photomicrographs. Most of these are good, and the descriptive portion is a concise and accurate account of what is requisite to be known from a bacteriological point of view about the pathogenic organisms alluded to. These organisms are *B. anthracis, tuberculosis, smegmatis, lepræ, mallei*; *Streptococcus, Staphylococcus*, and *Gonococcus*; *B. typhosus* and *coli*; *Pneumococcus* and *Pneumobacillus*; *Spirillum choleræ, Finkleri, Metchnikovi*, and *Deneke*; *B. pestis*; *Sp. Obermeieri*; *B. tetani, œdematis maligni, anthracis symptomatici*; *Actinomycosis*; and *Plasmodium malariæ.* Though the work only deals with the foregoing microbes, and though some organisms receive less attention than others, and perhaps less than they deserve, it should be welcomed as the first attempt to supply a want in English bacteriological literature.

There are two introductions, in one of which are described the photographic methods and procedures adopted and the apparatus used, while the other gives a useful description of the chief morphological characters of bacteria.

Though the inclusion of *Plasmodium malariæ* is warranted by the needs of those for whom the 'Atlas of Bacteriology' is intended, yet it is regrettable that this slipshod though current use of the word Bacteriology should have been adopted by the authors for the title of the book. It might easily be avoided in future editions by an alteration, or by the addition of a sub-title.

Bowhill's Bacteriology.‡—Mr. T. Bowhill's Manual of Bacteriological Technique and Special Bacteriology is, as its title implies, a work dealing with the practical side of Bacteriology, rather than with the controversial aspects of microbial diseases. The identification of micro-organisms is made a special feature both in the text and in the illustrations. The first part, about one-third of the volume, is occupied

* Comptes Rendus, cxxvii. (1898) pp. 1030–1. Ann. Inst. Pasteur, xiii. (1899) pp. 67–76.
† London, The Scientific Press, Limited, 1898, xiv. and 120 pp. (111 figs.).
‡ Edinburgh, Oliver and Boyd, 1899, 284 pp. (124 figs.)

by Technique, and deals with methods of sterilisation, preparation of nutrient media, cultivation of bacteria, the various procedures necessary for the demonstration of microbes, and descriptions of bacteriological apparatus. The rest of the volume is devoted to Special Bacteriology, a description of the more important Hyphomycetes, Blastomycetes, and parasitic Protozoa.

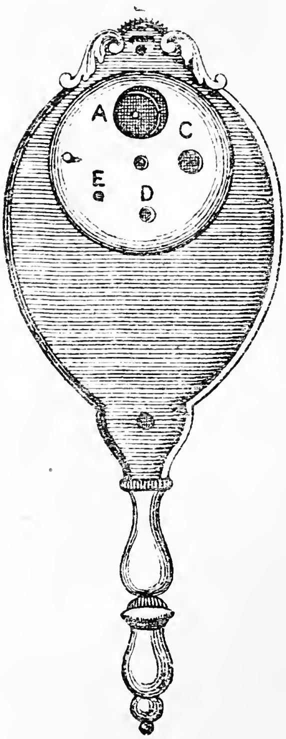
The most striking features of this useful and practical work are the excellence and number of the illustrations, nearly all of which are original; descriptions of the pathogenic Blastomycetes; and the prominence given to certain diseases affecting the lower animals.

MICROSCOPY.

[The Publication Committee of the Journal has decided on resuming the issue of the Microscopic Bibliography, which was dropped on the lamented death of Mr. John Mayall, jun. It is intended in future to give at least the title of every work or paper (commencing from January 1st, 1899) coming under the head of Microscopy A or of Technique 3 (Microtomes); and we shall be much obliged to any of our Fellows who will call our attention to any such papers or articles published in Journals which are likely to escape our notice.—EDITOR.]

A. Instruments, Accessories, &c.*

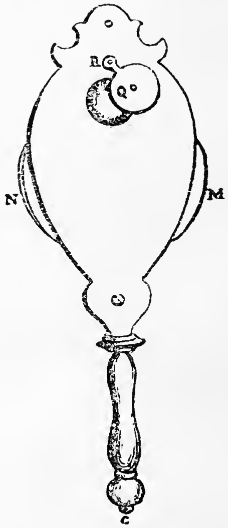
FIG. 30.



(1) Stands.

Evolution of the Microscope.†—Mr. E. M. Nelson has now published Part 2 of his monograph on this subject. The following is a list of the instruments described, arranged chronologically.

FIG. 31.



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

† Journ. Quekett Micr. Club, vii. (1898) pp. 98–118 (14 figs.). Cf. this Journal, 1897, p. 332.

1702. Really belongs to Part 1, and should be placed between Hartsoeker's and Wilson's screw-barrel Microscopes. Fig. 30, which is a back view, shows an oval wooden plate; on the other side is a similar plate which holds the lens opposite the aperture A. Between the plates is a rotatory multiple object-holder (M N, fig. 31), the object being inserted in apertures in the circumference of the disc. Focussing is accomplished by means of the milled head B, which is attached to a screw regulating the distance between the two plates; one of these carries the lens, and the

Fig. 32.

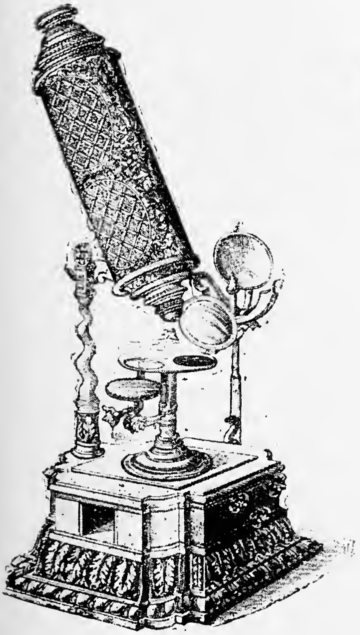
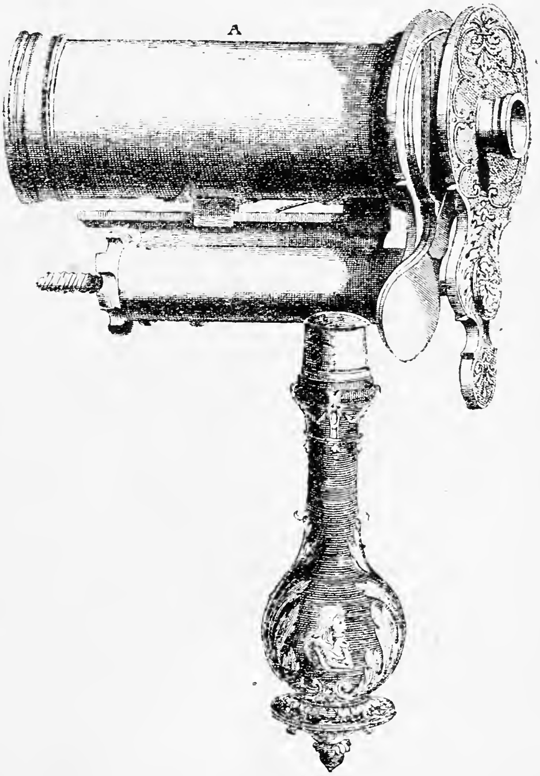


Fig. 33.



other the rotary object-holder. The great point of interest is the rotating wheel of graduated diaphragms, A B C D E (fig. 30), placed on the side of the object remote from the lens. This is the first instance of this useful and still surviving appliance.

1710. We meet a crude estimate of aperture; for Conradi says that the aperture of his object-glass was equal to a mustard seed. He also used a negative amplifier between the objective and eye-glass: this is the first notice of a Barlow lens.

1715. (Fig. 32.) In Hertel's Microscope the mount is of the "telescope stand" type, the inclination in arc being regulated by screw and nut. This is really a throw-back to an older type; for J. Marshall's (1704) Microscope possessed an inclinable limb carrying both body and stage, and was therefore far in advance of the telescope mount.

The important point about this Microscope is the adaptation of a mirror, which now appears for the first time; it also has a mechanical stage.

1718. Fig. 33 shows Joblot's simple Microscope. The ornamented plate carries the lens, the focus being adjusted by the nut and screw; the plate next the ornamental one is a concentric rotary stage. The mechanical details of this stage are well thought-out and properly sprung (fig. 34). The instrument is a decided advance on any preceding simple Micro-

Fig. 34.

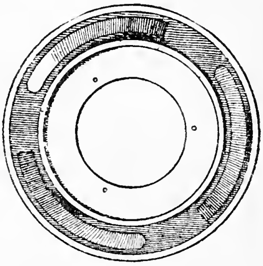
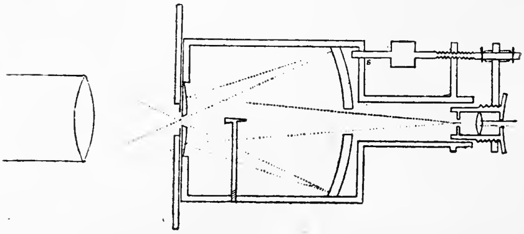


Fig. 35.



scopes, not only on account of the mechanical contrivance of the concentric rotating stage, but also for an optical one, viz. the placing of a diaphragm at the end of the tube.

Prof. Joblot also designed compound Microscopes; these, although their exteriors are ornate and of good artistic design, are of a very crude type; they possess, however, a concave lens in the covering cap of the eye-piece. This, when mounted in place of the convex eye-lenses, turned the instrument into what is now called a Brücke lens.

1736. Barker's catoptric Microscope, exactly like a Gregorian telescope, but of bad design.

1738. Smith's catoptric (fig. 35), very efficient of its class. It is like a Cassegrainian telescope, with this difference, that both mirrors are pierced with a hole through their centres. Dr. Smith calculated four of these Microscopes, the main difference between them being in the amount of spherical aberration they possessed. He also describes a substage condenser. This Microscope was not surpassed either theoretically or practically for about eighty or ninety years.

1738. Culpeper and Scarlet's "Double Reflecting Microscope" is the first instance of an English Microscope with an illuminating mirror (fig. 36). Baker, in his description of this instrument in 1743, adds a

Fig. 36.

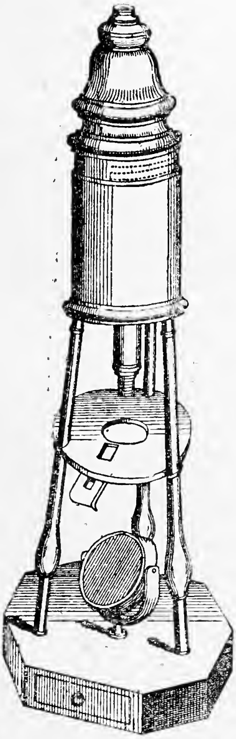


Fig. 37.

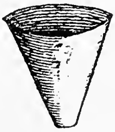
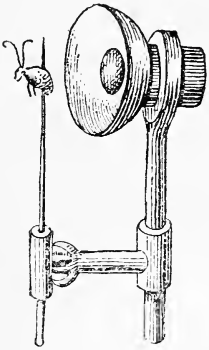


Fig. 38.



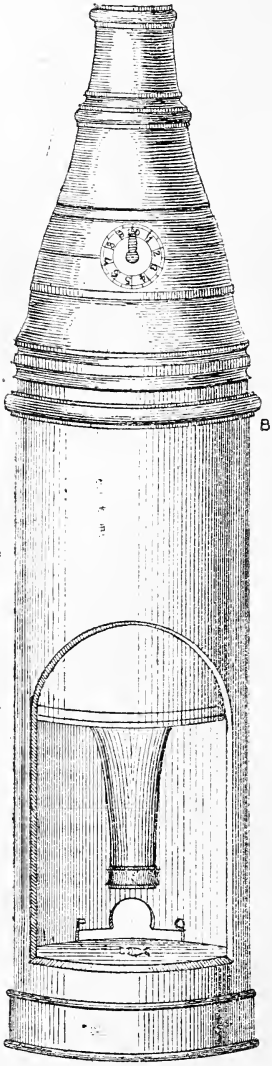
conical diaphragm of black ivory (fig. 37). A brass diaphragm of this form was subsequently made by Cuff, Marston, Adams, and in 1798 by Jones. Chevalier placed a graduated wheel of diaphragms at the lower end of the cone (1823), so that this peculiar form of diaphragm had an innings of about eighty years.

The Culpeper and Scarlet model remained the popular form for seventy years.

1738. In this year Dr. Lieberkuhn introduced his well-known form of reflector for the illumination of opaque objects; fig. 38 is a copy of a figure in a book by P. van Musschenbroek (1739).

1739. Benjamin Martin's Pocket Reflecting Microscope with a micrometer. The instrument was dioptric: the word "reflecting" applies solely to the illuminating mirror. Fig. 39 shows that it was of an entirely novel design; the focussing was performed by a push-tube at B; for illumination the outer tube was cut away in front, and a mirror placed at the bottom; there was also a wide aperture P Q cut through the opposite side of the outer tube for the purpose of allowing slides to be passed through. One of the novelties was a rough micrometer fitted in the focus of the eye-lens, with an attached dial for the purpose of registering tenths of a revolution of the screw. Subsequently the outer tube was prolonged, making what is now called a drum-foot, in which a mirror was placed; afterwards it was mounted on three legs, after the manner of the Culpeper.

Fig. 39.



1740. B. Martin's Universal Microscope was of crude design, exhibiting a throw-back to the telescope mount.

1740. Lieberkuhn's Solar Microscope, or, as we should now say, Projection Microscope. The apparatus, mounted on a ball-and-socket in a window, was originally pointed at the sun; but Cuff (1743) greatly improved it by attaching an elementary form of heliostat (see E, fig. 40). In 1746, Adams adapted his Microscope stand in a very ingenious manner to his projection apparatus, thus forming the earliest prototype of the projection and photographic instruments of the present day.

1742. Fig. 41 shows a scroll form of mount on a circular wooden foot, a great improvement over the complete telescope mount; but we see the last remnant of a partial telescope mount; for the Microscope could be turned round on the pin C D laterally, so that it might be pointed to the sky or to a candle flame. This form of instrument, as made by Adams, had the scroll in sections for the sake of portability, and, mounted on a square box foot, became very popular; it was still sold by Jones in 1798.

1743. Lindsay's Microscope (fig. 42) is a simple Microscope with a mirror. It has four points of interest: first, its extreme portability; secondly, its excellent workmanship; thirdly, it is the first Microscope in which we meet with a mechanical arrangement for changing the power; fourthly, it is the first Microscope patented. The date of the patent is 1743; but the inventor states that he designed and made it in 1728. If this earlier date could be established, it would be the earliest known instance of an English Microscope with a mirror. The Royal Microscopical Society possesses an excellent example of this Microscope, dated 1742, and numbered 22.

FIG. 40.

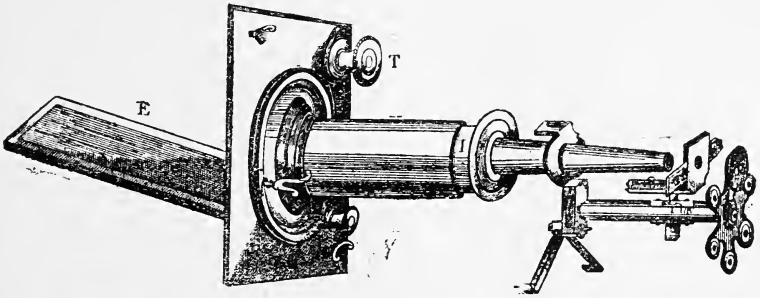
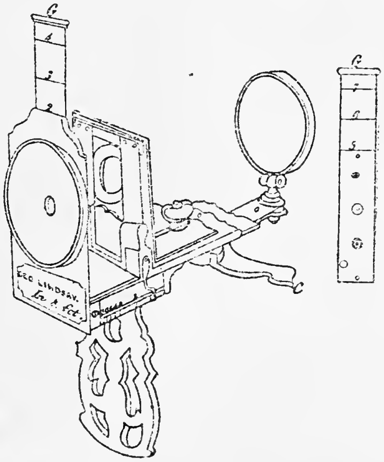


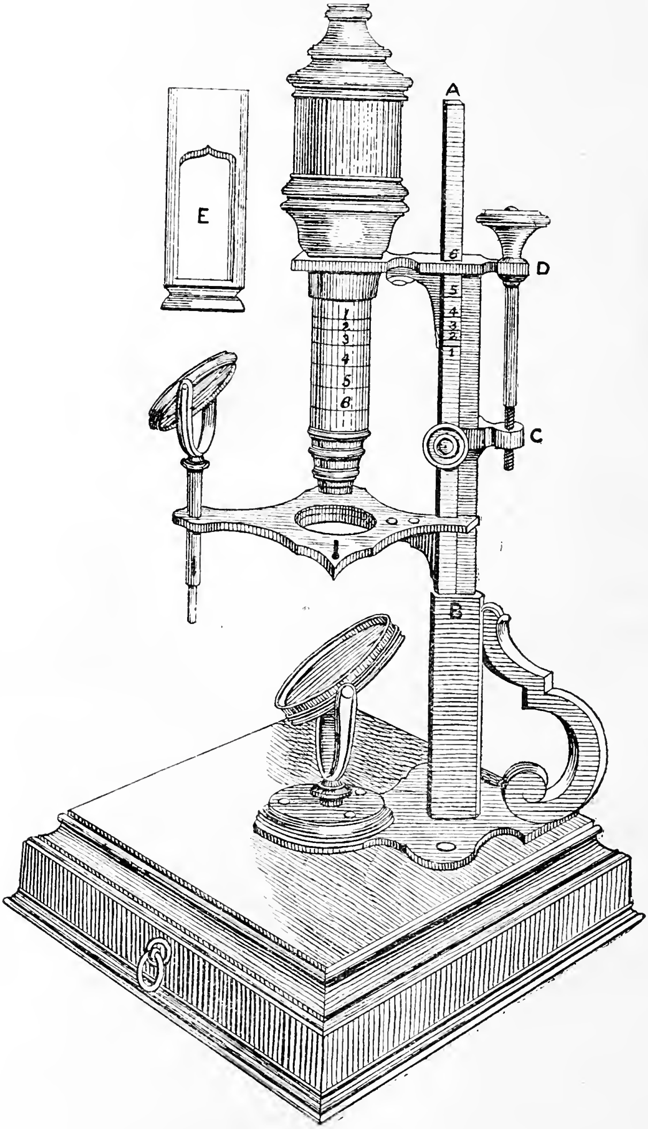
FIG. 41.

FIG. 42.



1744. Cuff's Microscope (fig. 43). The post A B is fixed to a square box foot, and the stage is fixed to this post. The bar behind and parallel to the post, to which the limb D carrying the body is attached, slides in the socket B. The thumb-screw in front clamps C, which is fixed to the movable bar, to the post A. The method of focussing is therefore simple and effective. The thumb-screw is loosened and the movable bar is placed to the figure engraved on the post A, corresponding to the number of the objective on the nose-piece. The

Fig. 43.



thumb-screw is then clamped tight, and further focussing performed by the fine adjustment D C.

Powell's Iron Microscope.—We have received from the President, Mr. E. M. Nelson, the following description of, and remarks on, Powell's Iron Microscope, exhibited by him at the meeting on February 15th. The accompanying figures (figs. 44 and 45) are the first illustrations that have been published of this beautiful and very useful model. It was the invention of that eminent mechanician, and father of the modern Microscope, the late Hugh Powell, an admirable portrait of whom we are able to present to our readers in the present part.

Fig. 44.

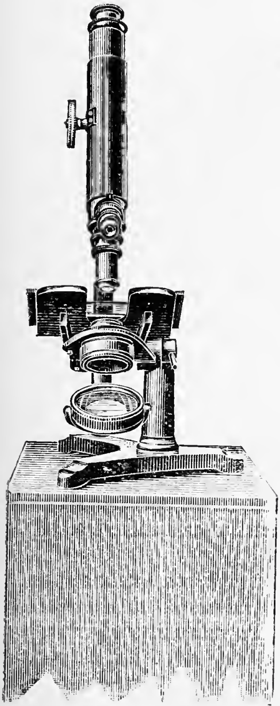
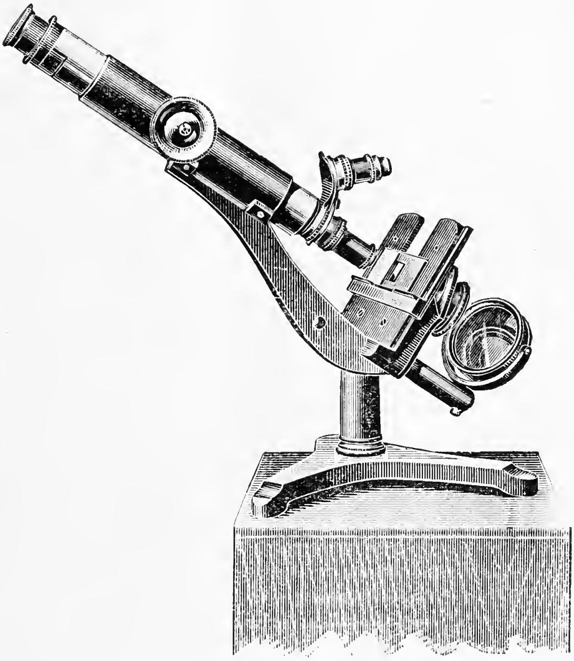


Fig. 45.



"The date of this instrument is about 1838–40, and a more thoroughly practical and serviceable model, for the work it is intended to do, has never yet been designed.

"The chief peculiarity in this Microscope is at once apparent, viz. that it is mounted at the side of a pillar, instead of on the top of a pillar, or between two pillars. There are three important points gained by this form of mount:—(1) stability, (2) free access to substage and mirror on the right-hand side, (3) compactness.

"Powell was wiser than our Continental friends, who, in order to avoid the Scylla of bulkiness, have run into the Charybdis of instability.

"But some critic may observe that this stand is not so compact as the large Continental forms. In reply to this it may be pointed out that this

Microscope is much larger, for it measures no less than 11 in. from the eye-cap to the objective front, and its stage area is 15·9 sq. in., viz. half as large again as that of the largest Continental instruments. The question may be asked, if a Microscope having a body and a stage of the above length and area were to be mounted on a horse-shoe stand of the Continental form, what size and weight of stand would be required, so that both instruments might have the same amount of stability when inclined in any position?

"This Microscope originally had a circular hole in the stage, but in 1880 I had the brass cut away to the front, in order that the slide might be more easily tilted by the finger against the objective front, so that the working distance might be ascertained. By this means an oil-immersion 1/12 of any aperture can be quickly and safely brought into focus by means of the coarse adjustment alone. In 1882, Messrs. Swift and Son made a Microscope for me with a similar form of stage; this is figured in the Journal R.M.S., 1883, p. 554, fig. 94. I have other Microscopes made on the same plan, and all give complete satisfaction. This form of stage is now largely adopted.

"The stage has a plain sliding bar, sprung; this works so smoothly that it can be moved by the pressure of the finger acting only on one side.

"The second peculiarity is that the Microscope has no fine adjustment. Powell always insisted that the quality of the fine adjustment was one of the most important factors in determining the perfection of a Microscope. He also gave it out as an axiom that a Microscope, fitted only with a good coarse adjustment, was better than one which had, in addition to the coarse adjustment, a rickety fine adjustment.

"In this he was perfectly right. I can remember that my second Microscope had a worthless short lever nose-piece fine adjustment; the result was that the fine adjustment was never used at all, focussing was performed solely by means of the coarse adjustment; the fine adjustment was therefore only in the way, and contributed instability to the nose-piece, and it is perfectly clear that the instrument would have been far better without a fine adjustment.

"Powell was unwearied in his efforts to perfect the fine adjustment, and the perfection to which it has been brought in the modern Microscope is wholly due to him. As a matter of history, Powell's fine adjustments were in advance of the requirements of the lenses of his day, which had very low optical indices; in illustration of this, let me point out that a Microscope of his, with stage focussing, made in 1838, works a modern oil-immersion apochromatic of 1·43 N.A. with steadiness and precision. When the apochromatics were brought out by Prof. Abbe in 1886, the Continental fine adjustments had all to be revised, because they were so defective that they were incapable of focussing these new lenses with large optical indices; while Powell's, on the other hand, were quite equal to the emergency, although constructed upwards of thirty years previously.

"My own opinion is, and has for long been, that a direct acting screw fine adjustment (other than a differential),* however well constructed,

* The differential screw fine adjustment was first applied to a Microscope by Nobert; see Monthly Micr. Journ., 1869, p. 324. It was first suggested by Dr. Goring in 1830.

is quite incapable of fully developing the image given by an oil-immersion apochromatic with a large optical index. In opposition to this it may be urged that most biologists and histologists use Microscopes of the Continental pattern; to which I reply that biologists and histologists always work their objectives down, and never up; by this is meant that an oil-immersion 1/12 is used where a 1/2 or a 1/4 ought to be sufficient. A lens used with a small cone is a lens 'degraded.'

"Now, as a general rule, biologists and histologists use the three-lens Abbe chromatic condenser, which only yields an aplanatic cone of 0·5 N.A., consequently an oil-immersion 1/12, however great its excellence, can only be used as a 'degraded' lens with such a condenser. A fine adjustment however is only put on its metal when a 3/4 cone is employed; you may be perfectly certain therefore that those Microscopists who are content with the efficiency of the direct acting screw fine adjustment, never employ a 3/4 cone, and use only 'degraded' objectives.

"Far be it from me to minimise the value of the work done by any biologist or histologist, but I think that the above remarks are called for, because it is tacitly assumed that, if any microscopist has discovered any biological object with a lens 'degraded,' therefore that method and apparatus must necessarily be capable of performing the highest and most critical microscopical work.

"Another misconception also is rife, viz., that the highest type of instrument must be the combination of a dissecting and observing Microscope; for we have been repeatedly told that because Strauss Durkheim designed, for the dissection of the Coleoptera, a Microscope which had the level of its stage four inches above the table, therefore four inches is the proper height for all Microscope stages. This is wholly an error, because the combination of two incompatible things cannot yield the best possible results for each. The best observing Microscope will never make the best dissecting one, and *vice versâ.*

"In this Microscope we have an interesting feature, viz. an early example of the 'Jackson' limb. The funny thing is that what is now known as the 'Jackson' limb was not invented by Mr. Jackson; for it was Mr. J. J. Lister who designed this form of limb, and it first appeared in a Microscope made for Mr. Lister by Tulley. The Microscope was completed on May 30th, 1826. Mr. Tulley states, in a pamphlet published about that time, that '. . . the instrument and its apparatus was suggested and made from original drawings by my friend J. J. Lister, Esq., whose ingenuity and skill in these matters are very generally acknowledged.' It should be also noted that Mr. Lister's Microscope had 'a combination of lenses to act as condenser under the object'; it also possessed an internal lens to erect the image; in this last point clearly predating Strauss Durkheim. You will also notice that the tube-rack coarse adjustment, and the limb of Powell's iron Microscope are copied from Mr. Lister's instrument which, like Powell's, also had no fine adjustment.

"The question now arises, what was Mr. Jackson's invention? It consisted in the ploughing of the slide which carried the body and that which carried the substage, in one plane, and out of one solid piece of metal. In this connection it is stated,* that 'in this way the axis of

* Trans. Microscopical Society of London, 1861, p. 37.

the instrument is perfectly continuous, and no centering or adjustment is required.' Mr. Jackson also introduced the double pillar; the carefully turned and correctly proportioned pillar was very likely to emanate from one who was well known to be such an expert with the lathe and other mechanical contrivances. You will notice that Mr. Jackson's improvements were far later in point of time than those of Mr. Lister; for if you will examine Mr. James Smith's Microscope that was made to the order of the Microscopical Society of London and delivered in November 1841,* you will see that it has the Lister limb, but neither the Jackson ploughed groove nor the Jackson double pillar.

"Thus a matter is explained, which for long I have been unable to understand, viz.:—why did Messrs. Smith and Beck never supply centering motions to the substages of their former models? The whole thing is clear now; for at the time those Microscopes were designed the necessity for extreme accuracy in centering had not arisen. When, however, objectives increased in power and aperture, centering gear was provided, in the form of an adapter which held the substage condenser, and which fitted into the substage. Other makers, who were not hampered with the idea of the sufficiency of the Jackson ploughed groove, fitted centering motions to the substage itself, and thus dispensed with the adapter. For the future, I intend to call all such mounts as the one before you this evening, by the name of the 'Lister limb,' for he most certainly was its inventor.

"The question will be asked, why did Mr. Lister take the trouble to invent a new form of stand, when he had the excellent models of Jones of Holborn ready to his hand? The answer to this is that just at the close of non-achromatism, the prevailing idea was that every first class Microscope should be, in the terminology of those days, both single and double, or as we should now say, simple and compound. Microscopes were therefore constructed with this idea in view; and to meet the requirements of a single Microscope, the transverse arm was pivoted so that the single lens might be made to traverse quickly over a stage, in the same way as a 'loup' on a modern dissecting stand does at the present time. In addition to this, the acting portion of the arm could be lengthened or made shorter, either by a sliding arrangement, or, as in the most highly finished instruments, by rackwork.

"Now it is obvious that all these movements were conducive to instability, especially when the compound body was screwed on to the arm above the single lens. Mr. Lister designed his rigid limb with the view of correcting these errors in the instruments of his time.

"In this he showed great foresight; for he evidently recognised the fact that the introduction of achromatism would so enhance the capabilities of the compound Microscope as to render its combination with the simple Microscope simply impossible, and therefore he determined that his instrument should be a compound Microscope, and that only. We of to-day may find certain points in his design deserving of criticism, such for instance as the steadying rods fixed to the eye-end, which evidence want of poise, &c.; but then we must charitably remember that the man who makes no mistakes makes nothing, and must give Mr. Lister

* Microscopical Journal, by Cooper and Busk, for 1842, frontispiece.

the credit of the invention of this improvement in the Microscope stand, which is to-day of such great service. The improvements effected by him in achromatic objectives for the Microscope are already acknowledged.

"In the same casting as the Lister limb there is a V-shaped bracket 7/8 in. thick; to the upper side of this bracket the stage is screwed, and to its lower side a plate parallel to the stage. This lower plate carries a sprung tube, which forms the substage. In this substage I have a push-tube focussing adapter, which carries a Zeiss 'improved aplanatic lens × 10'; this lens makes a very suitable achromatic condenser for the powers used on this Microscope. As the lens merely slides into a sprung tube, it can be easily removed for its ordinary use as a 'loup.' Below the adapter is a Gifford's screen.

"This condenser requires no diaphragm, because the objectives on the rotating nose-piece are a Zeiss a a, and a Reichert 8 mm.; with the first the condenser gives a full cone, which the a a stands perfectly well, and with the second a 3/4 cone, at which point the 8 mm. performs at its best. The magnifying powers are 70 and 170 diameters respectively, the diameter of the field being 8½ in.

"A Microscope of this description will be found very useful, not only for rough work, such as the examination of unmounted objects, and for roughly searching finished slides, but also for a hack Microscope, as a companion to a larger instrument on which critical work is being performed. I am told by biologists who have done a large amount of Microscope work, that the employment of a second Microscope is preferable to the use of a rotating nose-piece on the larger instrument. This I can well understand, because when the condenser has once been adjusted for critical illumination with a high power, it is very annoying to have to disturb it for lower-power work.

"*Dimensions of Powell's Iron Microscope.*

Body, 8 in. (203 mm.); diameter, 1⅛ in. (28 mm.).

Spread of foot, 7½ × 6 in. (190 mm. × 152 mm.).

Distance of optic axis from table when the Microscope is placed in a horizontal position, 5½ in. (140 mm.).

Stage, 4⅜ × 3⅝ in. (111 mm. × 92 mm.).

Height of stage from table, Microscope being in a vertical position, 4¾ in. (120 mm.).

Rack extension, 2¼ in. (57 mm.).

Cut in stage, wide, 1$\frac{3}{10}$ in. (33 mm.); depth, 2½ in. (63 mm.).

Distance from eye-cap to front lens, 11 in. (280 mm.).

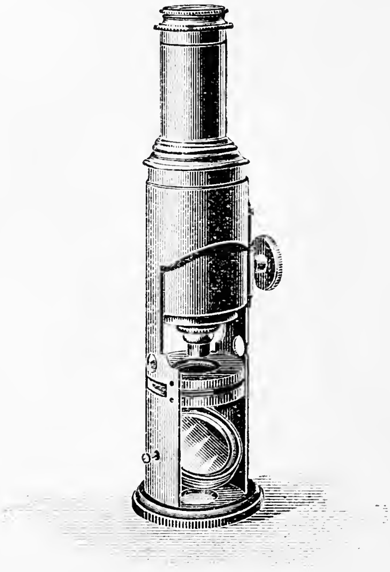
Weight, 6½ lb. (3 kg.).

The brasswork is finished bright, and the ironwork japanned green; cork is plugged in the feet."

Martin Microscope.—Fig. 46 illustrates a Microscope alleged to have been made by Benjamin Martin, and presented to the Society last year by Mr. Alfred George Fryett, of Melbourne, Australia. This has evidently been evolved from B. Martin's first Microscope, which he called a "Pocket Reflecting Microscope,"* an account of which was published in 1739.†

In the library of the Society is a collection of B. Martin's tracts (1765), in which an improvement of his "Pocket Reflecting Microscope" is figured, pl. 2, fig. 13. This improvement consisted in prolonging the tube, and placing below the stage a mirror, capable of being inclined, for the purpose of illuminating transparent objects. Note that the term "reflecting" applies solely to the mirror used for the purpose of illuminating transparent objects, and does not imply that the instrument was on the catadioptric principle.

Fig. 46.



Martin's improved Microscope is now known as the drum-foot; it is still made in France, and is occasionally to be seen in our toy shops. This form of Microscope was adopted by Fraunhofer (1816),‡ Oberhäuser (1835, patented 1837), Lerebours (1838).

Martin's second improvement consisted in the adaptation of the Culpeper and Scarlet tripod foot, a form which has long since passed away. This is figured in his 'Optical Essays,' fig. 21, no date (bound up with his tracts).

The Microscope in fig. 46 is a later form of his drum Microscope, further improved by the addition of a rackwork coarse adjustment. This Microscope is neither signed nor dated. B. Martin died in 1782, and the instrument appears to be of a much later date than that. The box contains a cut of the instrument, with a descriptive text, in which it is called Martin's Microscope; but it does not appear to be older than the first half of the present century.

Early Form of Ross Microscope.—Messrs. Watson and Son have very generously presented an interesting and early form of a Ross Microscope to the Society (fig. 47). The Microscope is on the Lister model, fitted with a rack-and-pinion coarse, and a short-lever nose-piece fine adjustment, the fine adjustment screw being at the side, instead of in its usual position, the front of the body.

The stage has rectangular mechanical movements, both being performed by rack-and-pinion, the heads of both the pinions being placed

* This Microscope is figured in a book in the library of the Society, viz. 'A Treatise on the Microscope,' by B. Martin, 1742, fig. 1; also in Journ. Quekett Micr. Club, vii. (1898) p. 11, fig. 20.

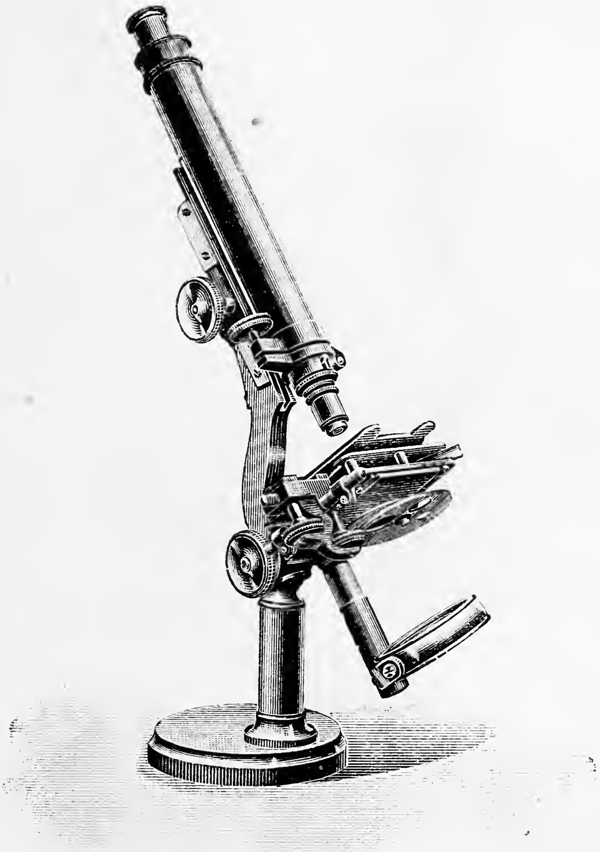
† For this date see 'Adams on the Microscope,' second edition, 1798, p. 21, footnote.

‡ For this date see 'Les Microscopes et de leur usage,' C. Chevalier, 1839, R.M.S. library.

in a vertical position below the stage. It will be observed that on account of both movements being performed by rack-and-pinion, an equal speed is obtained for each. The slide-holder is of the non-concentric rotary type. There is no substage proper, but a sliding plate carrying a rotary wheel of diaphragms is fitted instead of one.

The foot is particularly interesting; it is circular with the vertical

Fig. 47.



pillar attached excentrically to it; the base rotates so that great stability can be secured when the Microscope is used either in a vertical or inclined position.*

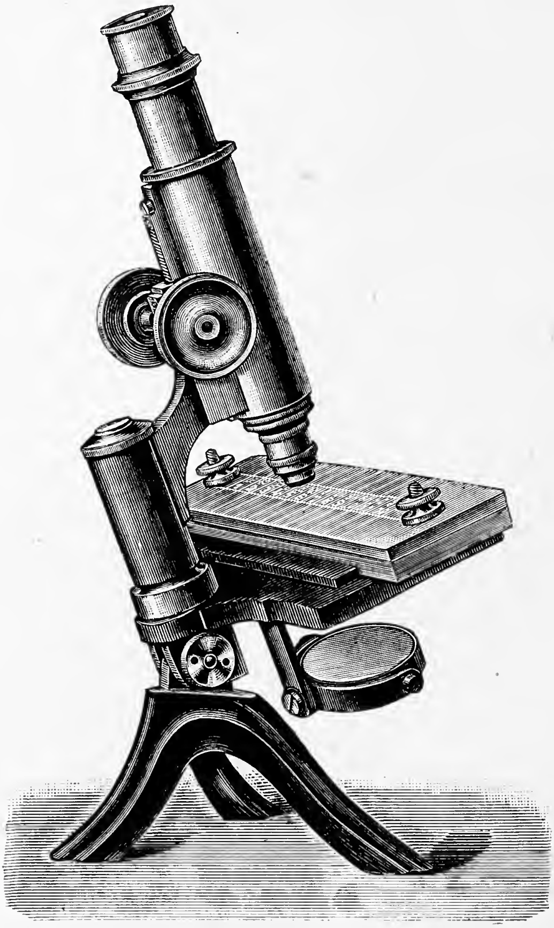
This Microscope is signed And^w. Ross, and has his address,

* For the earliest form of this often reinvented adaptation see a Microscope by J. Cuff, *circa* 1765, figured Journ. R.M.S., 1898, p. 675, fig. 117.

33 Regent Street, Piccadilly, engraved on it; it is also numbered 33. Probable date, 1842, 43.

Hartnack's New Microscope for Flesh Inspection.— In external build this instrument resembles somewhat the English model. It is

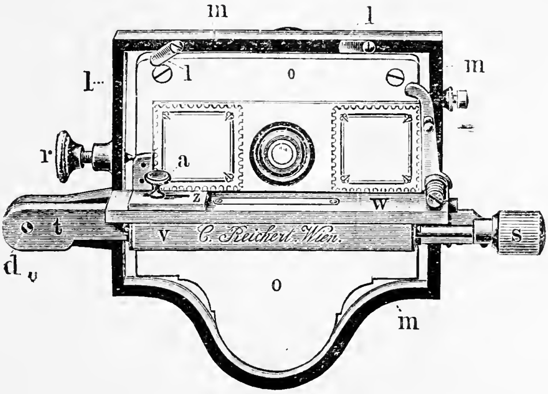
Fig. 48.



fitted with a specially broad table-plate (170 × 80 mm.), in order more conveniently to explore a compressorium with a larger number of preparations. The adjustment is by rack-and-pinion.

Reichert's Mechanical Stages.—Fig. 49 is a less expensive form of the stage already figured in our Journal, 1893, p. 527, and can also be used with smaller stands. It is a combination of sliding bar and mechanical stage. The object is moved from side to side by the milled head *s*; *s*, acting as a lever, also enables the object to be moved from top to bottom of the stage.

Fig. 49.



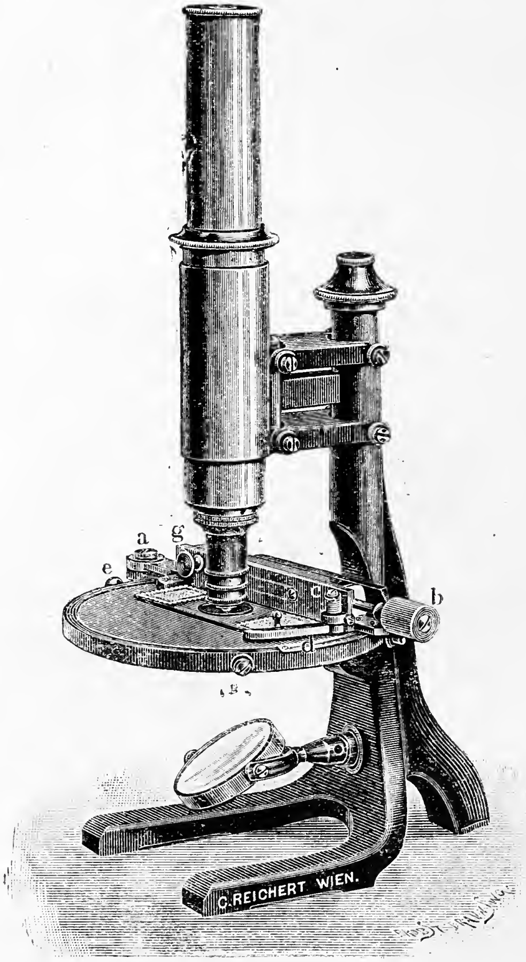
Reichert's Cheap Stand.—Fig. 50 shows a stand called No. VII. by this firm. It is said to be an excellent stand for many purposes, for medical, botanical, and other students, and for examination of meat for trichinæ. It is not inclinable—no disadvantage for some work—and Reichert strongly recommends it to those requiring a low-priced instrument. The coarse adjustment (not shown in figure) is by rack-and-pinion, and the fine by micrometer screw on Roberval's principle. It has a large round stage and a plane and concave mirror. If a sliding-tube coarse adjustment is substituted for the rack-and-pinion, a further economy is introduced.

Price, with rackwork coarse adjustment, 2*l.* 10*s.*; with sliding-tube coarse adjustment, but without mechanical stage, as in fig. 50, 1*l.* 14*s.*

Folding Dissecting Microscope.—Messrs. Bausch and Lomb's instrument bearing this name (fig. 51) is compact and portable. It has all the elements of the ordinary dissecting Microscopes, and besides these, the important feature that, when folded, it is brought into a very small compass. The base is japanned iron. The stage is of brass, blackened; it has spring clips and, in its centre, a removable glass disc with millimetre scale ruled upon it. It is of convenient height, so that any amount of work may be done without fatigue. The arm holding the lenses is adjustable in the triangular rack-rod, and has the Society's screw, thus permitting the use of low-power objectives as simple magnifiers. The mirror is detachable from the base, and can be readily attached to the stage for illumination of opaque objects. In folding, the rack is brought down and the arm detached; the stage swings backward on the pillar and the base on the stage, so that the space occupied is merely the size of the base and thickness of base, stage, and arm.

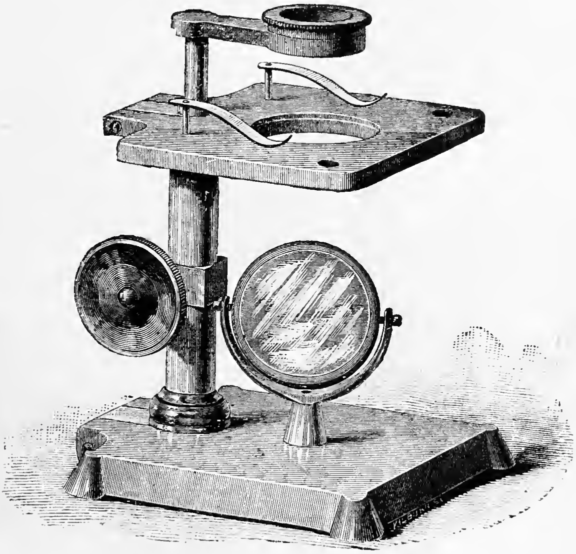
Paul Meyer's Dissecting Stand (Improved Form).—This (fig. 52) is one of Messrs. Bausch and Lomb's instruments, and is the largest dissecting stand made by them. The metal parts are brass throughout, polished and nickeled. The base is of unusually large size, and heavily

FIG. 50.



leaded to ensure stability. The stage plate, 90 × 105 mm. in size, is of polished plate glass, resting on a metal frame into which the spring clips are also fastened, thus making the entire surface of the stage free and available for work. Dishes may be cemented to its surface, or reagents used upon it, without fear of damaging it in any way. The mirrors are very large, 68 mm. in diameter, plane and concave. The usual somewhat cumbersome methods of securing black or white backgrounds are superseded in this stand by a plate, black on one side, white on the other, hinged to the stage frame, just beneath the front left-hand corner, by means of an arm of the proper length to bring the plate (black or white side up as required) directly in contact with the lower surface of the stage, or permitting it to be carried outward, beneath and against the hand-rests. When transmitted white light is wanted, the arm of the plate is brought to the vertical position and the white side of the plate used as a reflector, as this arrangement of the plate does not

Fig. 51.

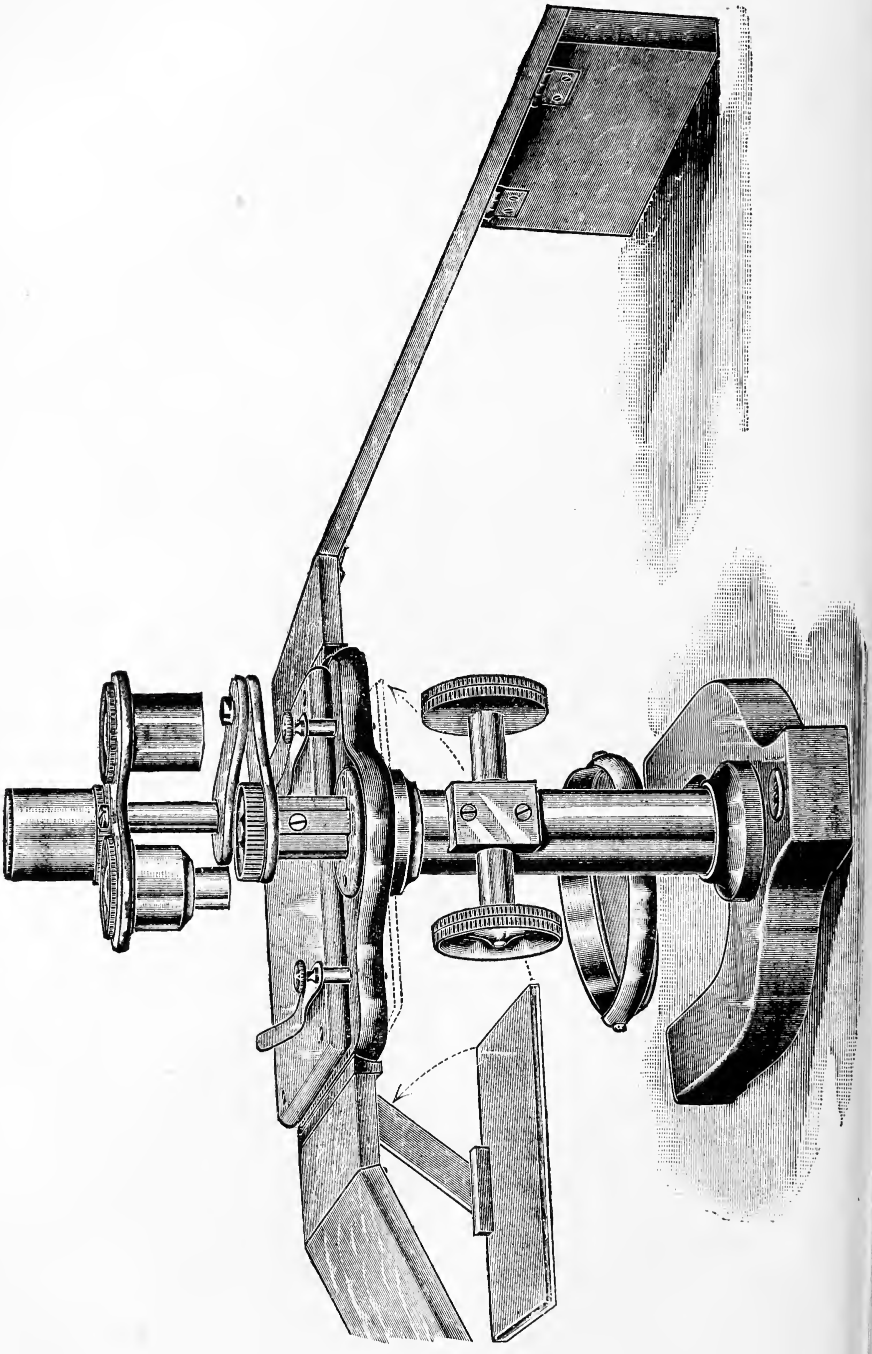


in any way interfere with the illumination or the use of the camera lucida.

The lenses are focussed by means of diagonal rack-and-pinion of extremely long range, acting on a triangular rod. The working distance may be increased to 125 mm. by means of a second rod attached to the arm and adjustable in the main focussing rod.

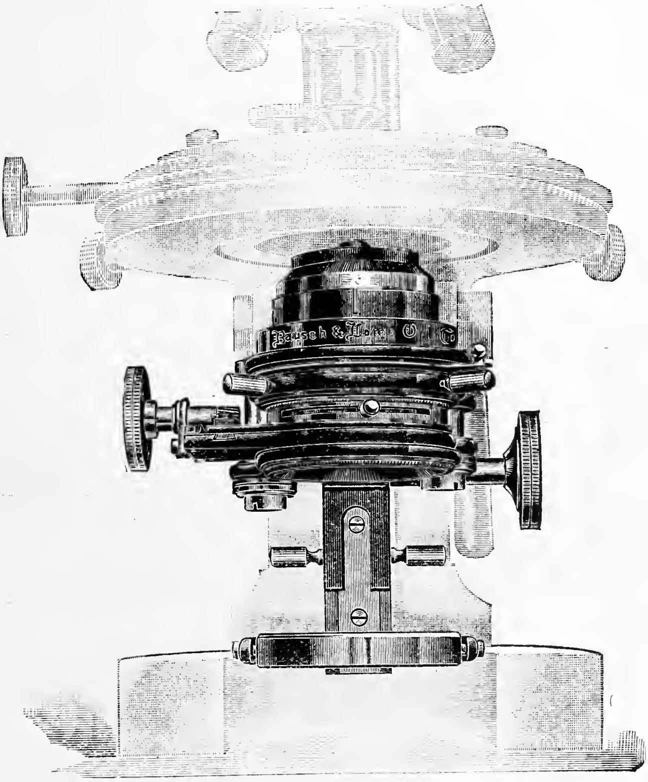
Bausch and Lomb's New Complete Substage.—Figs. 53 and 54 show the substage closed and separated. It has been especially designed to afford greater stability and convenience than are usually attained. The entire substage is supported on a heavy metal bar joined to the main arm of the Microscope, and to which it is attached by slide with rack-and-pinion, whereby the whole substage may be adjusted with reference to the Microscope stage. The substage is composed of three

Fig. 52.



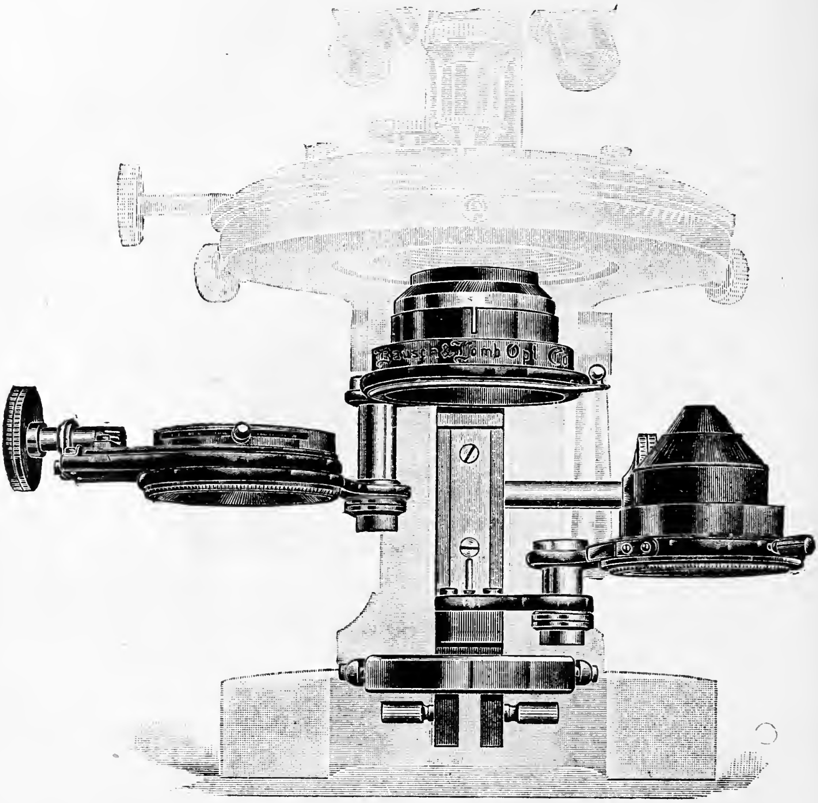
parts arranged one above the other. The upper part consists of a fixed ring, supporting the removable iris diaphragm. This diaphragm is operated by a lever, easily accessible from the front of the substage, and is so arranged as to come directly in contact with the object-slide if desired, thus being in the most effective position for use without the condenser. When the condenser is in use, this iris can be used to limit the volume of light entering the objective without limiting the angle of the illuminating cone. This method of controlling the light is of the

FIG. 53.



utmost importance in the examination of highly refractive transparent bodies, such as living bacteria, &c. The middle section of the substage is movable vertically on the main substage axis, and consists of a ring, with centering screws, carrying an Abbe condenser 1·20 N.A. The condenser ring swings laterally to the left of the instrument in such a manner that the condenser is entirely out of the path of rays from the mirror, and is also perfectly free for changing accessories. The condenser ring, the arm on which it is carried, and the sliding support, are all of the most stable construction, so that there is perfect rigidity and accuracy of centering throughout. The vertical adjustment of this section of the substage permits the condenser to be brought in immersion contact with the object-slide, or to be placed in any other position desired without reference to the position of the upper iris diaphragm. The

Fig. 54.

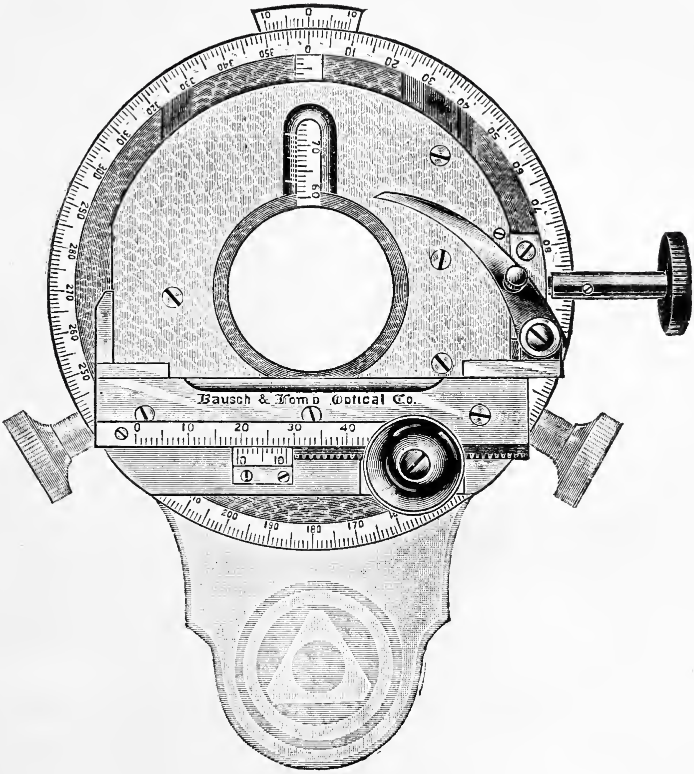


lower section of the substage carries the large iris which is used below the condenser. This diaphragm may be swung from under the condenser to the right of the instrument. It is so mounted that it may be rotated upon its own axis, and is laterally movable by rack-and-pinion when oblique illumination is desired.

Bausch and Lomb's Revolving Mechanical Stage.—The entire stage (fig. 55) rotates on its axis, the circumference being divided into 360 degrees, and provided with vernier reading to tenths of a degree.

The rectangular movements and object-carriers are the same in construction as those of the "Attachable Mechanical Stage." The graduations are placed so as to be viewed conveniently, and have verniers reading to tenths of a millimetre.

Fig. 55.



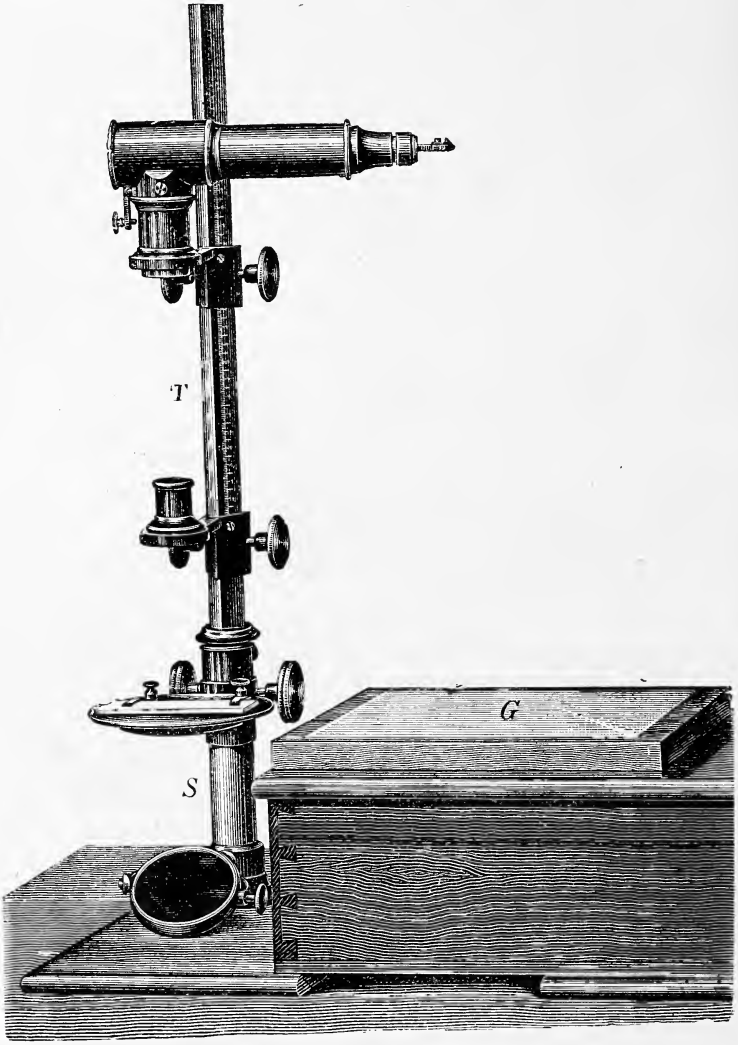
(3) Illuminating and other Apparatus.

Hartnack's Embryograph.—This instrument is mainly a more compact form of one designed by Professor His, of Leipzig, and is intended for outline drawing under low powers, with the advantage of changing easily from a given scale to any other. One of Oberhäuser's cameras is combined with a small photographic objective of such a kind that both these articles can be moved up and down on a 60 cm. long, graduated guide-bar T, and their mutual distance can be altered within comfortable limits. The foot of the guide-bar bears the sliding object-table and below that a Microscope mirror.

Fig. 56 shows the instrument mounted on a foot-board; but this is now replaced by an iron foot, thus increasing the stability. The ground-glass plate G serves as the drawing surface, and is placed at a suitable height on the adjoining box. All the parts of the apparatus can be packed away within a box 38 by 22·5 cm. and 9·5 cm. high.

The apparatus allows a magnification of 4–75 diameters.

Fig. 56.



Hammarberg's Object Net Micrometer.*—Dr. Hans Berger, of Jena, gives an account of the instrument invented and described by the late Dr. Hammarberg, a Swede, in his work on the pathology of idiocy. The

* Zeitschr. f. Instrumentenk., 1899, pp. 303–10 (3 figs.).

inventor's object was to compare the number of nerve-cells in 0·001 cubic mm. of brain of normal and weak-minded individuals.

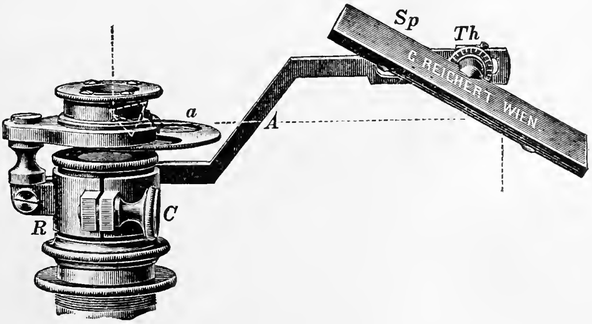
Hammarberg's method was to dispense with ocular micrometers, and instead to use the positive image of a 1 square cm. glass plate divided into 0·25 square mm., the image being thrown by a convex lens on to the preparation. The advantage of the arrangement is that, by increasing or lessening the distance of the lens, the image of the graduated plate on the preparation can be enlarged or reduced, and that this picture becomes an integral part of the preparation; magnification, therefore, by the objective and ocular does not alter the ratio between the preparation and the scale. The glass plate is so arranged that each little square on the object is exactly 0·01 sq. mm. An inconvenience arising from spherical aberration in the peripheral parts is avoided by selecting a central portion. After counting the cells in a certain number of squares, those in ten consecutive serial sections of 10 μ thickness, or in five of 20 μ, are counted. This total is divided by the proper number of squares, and the quotient gives the number in 0·001 cubic mm. of brain cortex.

Dr. Berger, having found the method satisfactory in brain investigations, describes the details of the apparatus, and thinks that the idea is capable of further microscopic application.

This ghost-micrometer was invented by Dr. C. R. Goring,* and was reinvented by Dr. G. W. Royston-Pigott,† and again by Prof. A. E. Wright.‡

Reichert's New Form of Drawing Apparatus.—Fig. 57 shows this apparatus, which can be used with dissecting Microscopes and poorly lighted opaque objects as well as for ordinary work.

Fig. 57.



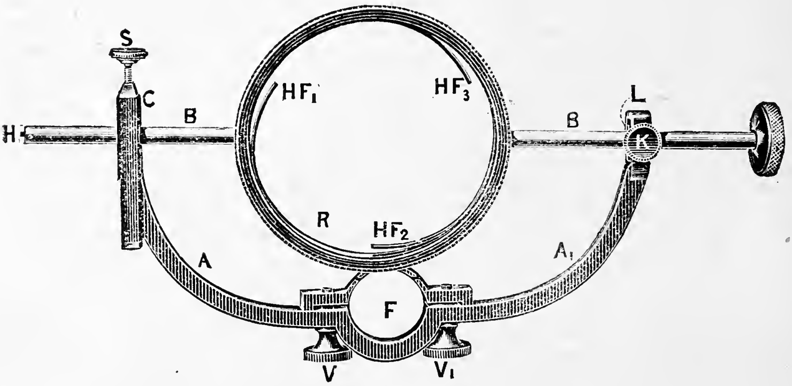
(4) Photomicrography.

Culture Dish-holder for Microscopic and Photomicrographic Purposes.§—This has been made by the Zeiss firm to Dr. W. Gebhardt's

* Micrographia, 1837, p. 51. † Monthly Micr. Journ., 1873, pp. 2 and 51.
‡ Cf this Journal, 1897, p. 245.
§ Zeitschr. f. wiss. Mikr., xiv. (1898) pp. 155-9 (1 fig.).

designs, and is intended to obviate the many difficulties incident to the fixing of the dishes on ordinary Microscope stages. The designer considers that a satisfactory holder should be capable of the three following motions:—(1) a radial push-motion; (2) a rotation; (3) a central lateral movement of at least 5 mm. in each direction, apart from the due centering of the culture layer. Fig. 58 shows how these requirements were perfectly attained. On a hollowed-out piece F, fastened by two screws V V_1 to the prism flange of the Microscope, there extend antler-wise two bent arms A A_1. The extremity of A_1 carries a threaded socket L, and the extremity of A is arranged for the adjustment. L receives the

Fig. 58.



axle B, which is firmly clamped by the tightening of the screw K. The centering arrangement C consists of a brass block with a double concave perforation ( ][in long. section), whose least cross-section receives the axle B without loose play. The axle B is interrupted in its midst by a ring arrangement R, formed of an inner and an outer part. The outer simple ring is of cylindrical cross-section, and its inner diameter about 105 mm. Within this ring (milled) is a second, much thinner, fitted with three clamps H F_1, H F_2, H F_3, tipped with cork or vulcanite, for reception of the dish.

When in use the ring arrangement R lies flat on the object-table.

Spitta's Photomicrography.*—This work, published by the 'Scientific Press,' is mainly a reprint of the articles which recently appeared in the 'Pharmaceutical Journal' and were abstracted in this Journal.† The book is got up attractively, with forty-one half-tone reproductions and sixty-three text illustrations. The size is a large quarto, and some useful appendices are inserted. All theoretical discussion has been avoided, with the hope of producing a practical manual, the embodiment of the author's experience. The half-tone reproductions are the work of Messrs. Dent and Co., of Clapham.

* London, Scientific Press (Lim.), 1899, 4to, 163 pp.
† Cf. this Journal, 1898, p. 591.

(5) Microscopical Optics and Manipulation.

A Treatise on Photographic Optics, by R. S. Cole.*—The contents of this book are well described by its name; for its scope embraces a discussion of the optical principles and optical difficulties of photography. In one sense it is not a practical manual, for it only incidentally notices applications of the art, and does not even make a reference to photomicrography. It avoids the ground of the ordinary handbook to photography, and does not trouble itself with the composition of solutions, the make of stands, or with manipulative details at all. But within its limits it is very practical, and is written with a clearness and a mastery of the subject that must place it high on the list of works of a similar nature. All points of theoretical interest connected with light and lenses are thoroughly explained, and are then elucidated by a conclusive experiment performed usually with quite ordinary apparatus. The mathematical treatment is simplified as much as possible, but not so much so as to be unintelligible, and is invariably followed by a well-chosen numerical example fully worked out, so that no reader need be in perplexity about the meaning of a formula. But while no mathematics are used beyond the simplest trigonometry, the principles underlying those parts of the subject requiring more elaborate mathematical analysis are clearly stated, and the experimental illustrations remove all uncertainty. In this way such difficulties as "least circle of aberration,' "astigmatism," are freed from their usual obscurity. The illustrations are very numerous and well drawn, and the type is excellent. In his preface the author states that he has tried to avoid producing a book which should be useful only to the professed mathematician and physicist, but the mode of treatment will commend it to all interested in optics. A possible improvement in a second edition would be an appendix on optical bibliography. The contents of the book are in seven chapters:—i. On Light (pp. 3–38). ii. Elementary Theory of Lenses (pp. 39–121). Thin and thick lenses are very fully discussed on the Gauss method; magnification; combinations; Dallmeyer's telephotographic lens; perspective; swing-back. iii. Aberration (pp. 122–39). Spherical, including astigmatism; chromatic. iv. Correction of Aberration and Design of Lenses (pp. 190–204). v. Lens Testing (pp. 205–50). Tourniquet System; Kew system. vi. Exposure, Stops, and Shutters (pp. 251–93). vii. Enlargement, Reduction, Depth of Focus, and Halation.

(6) Miscellaneous.

Pakes' Cover-glass Clip for making Blood-films.—This consists of a block of mahogany, B, fig. 59, with a strip of cork let in flush with its upper surface. The brass spring plate A grips the cover-glasses C upon the cork, and holds them fast.

The advantages of this cover-glass clip over the forceps usually employed are:—that more than one cover-glass can be streaked with blood at a time; that it is possible to obtain a single layer of blood-discs; and that the cover-glass is not so liable to get broken.

The clip was devised by Mr. W. C. C. Pakes, of Guy's Hospital

* London, Sampson Low, Marston and Co., 330 pp., many illustrations.

bacteriological laboratory, who finds it exceedingly convenient to streak the blood upon the cover with the edge of a machine-cut cigarette paper.

Fig. 59.

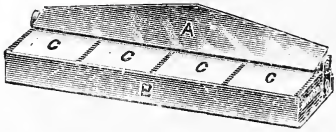
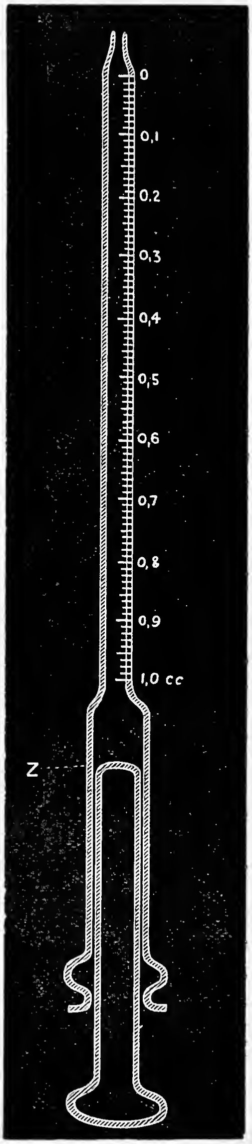
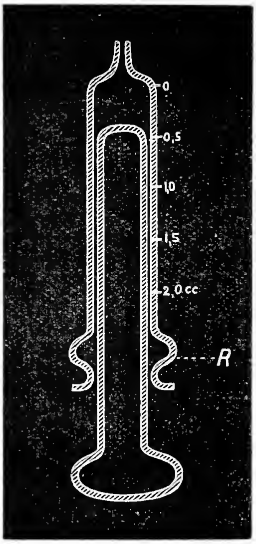


Fig. 61.



Modifications of an Aseptic easily Sterilisable Glass Syringe.* — Dr. S. Glücksmann describes two modifications of the Haegler-Passavant injection syringe. This syringe consists of a graduated glass tube, pointed at one end for the cannula, and a glass piston-plunger. On pushing up the plunger the fluid frequently returns, escaping at the posterior end. This inconvenience is avoided by the device shown in fig. 60, at R. The modification consists in having a groove at the posterior end, so that any return fluid collects therein and does not escape.

Fig. 60.



Another modification is shown in fig. 61. As will be seen by comparing the two illustrations, the second modification consists in an

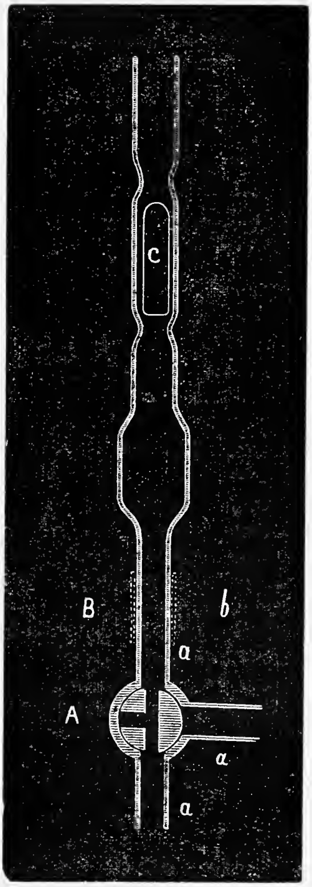
* Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 18–9 (2 figs.).

elongation of the nozzle in the form of a fine pipette marked with 100 divisions. This shape is intended for the injection of quantities which may be as minute as 0·01 ccm.

Z is a mark indicating the place to which the piston should be withdrawn before introducing the injecting fluid.

Improved Filter for Microscopical Water Analysis.* — Mr. D. D. Jackson has devised an attachment to the Sedgwick-Rafter filter which obviates the chief defect of the original apparatus. By the older process many Protozoa escaped enumeration, and this difficulty has been got over by means of the attachment to the filter-funnel, which holds back a definite quantity of the original water in the funnel. This attachment consists of a prolongation of the filter-tube, and is closed at the bottom by means of a solid rubber stopper. A smaller tube is connected with the main tube by a T-joint, and rises just to the level of the 6 ccm. mark on the funnel. This tube is of such a height that when the solid rubber stopper is in place, all the water may filter through the sand, except five cubic centimetres.

Fig. 62.



Automatic Measuring Pipette.† — Herr F. Kern describes an automatic pipette for measuring off definite quantities of germ-free fluids. Its chief advantage is that it can be worked by one person. It consists of three parts (fig. 62):—a T-shaped glass tube with a three-way tap at A, a reservoir, and a float-valve *c*. The reservoir may be made in one piece with the three-way tap, or connected at B by a rubber tube. The float *c* has its upper end rounded off to fit into the narrowed part of the reservoir, and so close the upper aperture. The reservoir is filled from below by siphon action; and as the fluid rises, the float is pushed up so that it closes the reservoir when the latter is full. The horizontal tube is connected with the long arm of the siphon, and the vessel containing the fluid with the short arm. The action is started by sucking at the upper end of the pipette. When the reservoir is full, the tap is turned to the left so that the fluid is evacuated below. This done, the tap is returned, after which the apparatus fills itself. For different quantities of fluid, reservoirs of different sizes are required. An apparatus similar in principle was described by Kuprianow.‡

* Technology Quarterly, xi. (1898) pp. 241–5 (1 pl.).
† Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 75–7 (1 fig.).
‡ Cf. this Journal, 1894, p. 400.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Coloured Nutrient Media.†—Dr. C. J. Rothberger records in tabular form the results of his experiments with bacteria on coloured nutrient media. In all, some thirty-five different pigments were used. Three groups of bacteria were inoculated on agar tubes coloured with the different pigments. The bacterial groups were vibrio, coli, and Friedländer. For the details the original should be consulted.

Apparatus for Anaerobic Plate Cultures.‡—Herr A. Klein has devised an apparatus for anaerobic cultivation, which combines the use of the vacuum air pump and pyrogallic acid for the removal and absorption of air. On a ground-glass plate is placed a bell-jar 18 cm. in diameter and 30 cm. high. At the top is an aperture plugged with a caoutchouc stopper perforated for the insertion of a glass tube, which is connected with the air pump.

At the bottom of the bell-jar is placed a flat glass pan which just fits into the bell-jar. In this are placed 2·5 grm. of pyrogallic acid. Inside the bell is also placed a small apparatus composed of two U-shaped tubes supported on a metal stand. One end of each tube is closed and the other open. The small tube is filled with mercury, and is provided with a scale for registering the pressure in the bell-jar. The closed limb of the wide tube is quite filled, and the short limb partially filled, with 60 per cent. caustic potash solution. To the latter limb is connected a siphon, wherein the caustic potash solution stands a little higher than in the short open leg of the tube. When the pressure has sunk to the attainable minimum, the potash solution in the open limb and in the siphon has risen high enough to bring the siphon into action; the potash solution is thus brought into contact with the pyrogallic acid in the pan. As soon as the siphon is empty, the tube at the top of the bell-jar is clamped, and the apparatus is ready to be placed in the incubator. There is sufficient room inside the bell-jar for ten Petri's capsules.

The advantages claimed for this apparatus are that it is ready for use in less than ten minutes; there is complete removal of oxygen, as is indicated by the colour of the caustic potash solution; it works with perfect certainty.

Cultivation Medium for Bacillus of Hooping Cough.§—In the course of a long description of a bacterium found in the sputum of cases of pertussis and identical with the microbe already described by Czaplewski and Hensel,|| Dr. O. Zusch states that he has obtained very favourable cultivation results from the use of ascites or anasarka-glycerin-agar. This medium answers better than the Loeffler's serum employed by Czaplewski and Hensel.

* 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, &c.; (6) Miscellaneous.

† Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 15–17, 69–75.

‡ Op. cit., xxiv. (1898) pp. 967–71 (2 figs.).

§ Tom. cit., pp. 721–7, 769–79 (1 pl.).

|| Cf. this Journal, 1898, p. 227.

(2) Preparing Objects.

New Preparation for Rapidly Fixing and Staining Blood.*—Dr. L. Jenner has introduced to histological technique a solution which works admirably as a blood-film fixative and stain. It is made in the following way:—Equal parts of a 1·2 per cent. to 1·25 per cent. solution of Grübler's water-soluble eosin, yellow shade, in distilled water, and of a 1 per cent. solution of Grübler's medicinal methylen-blue in distilled water, are mixed together in an open basin and thoroughly stirred with a glass rod. After 24 hours the mixture is filtered, and the residue dried either in the air or in an incubator at (not exceeding) 55° C. When quite dry the residue is scraped off the filter and powdered. It is then again shaken up with distilled water and washed on a filter, and after having been dried again is powdered. For use, 0·5 grm. are shaken up with 100 ccm. of pure methyl alcohol, and the filtrate used as the fixative stain. The solution keeps well.

The stain may also be made by dissolving the eosin and methylen-blue in methylic alcohol, and mixing them in the proportion of 125 ccm. of a 0·5 per cent. solution of eosin and 100 ccm. of a 0·5 per cent. solution of methylen-blue.

Cover-glass preparations are made by pouring a few drops of the solution on the dry film, and allowing the solution to act for one to three minutes. The stain is then poured off, and the cover-glass rinsed in distilled water until the film assumes a pink hue (5–10 seconds). The cover-glass is then dried, preferably in the air. The red discs are terra-cotta coloured; the nuclei of white corpuscles blue; the platelets mauve; the granules of the polymorpho-nuclear white cells and of myelocytes are red; those of the basophile or mast cells dark violet; and bacteria, filariæ, and malaria parasites blue.

The inventor claims for the new method that it demonstrates more plainly, readily, and simply than those in general use.

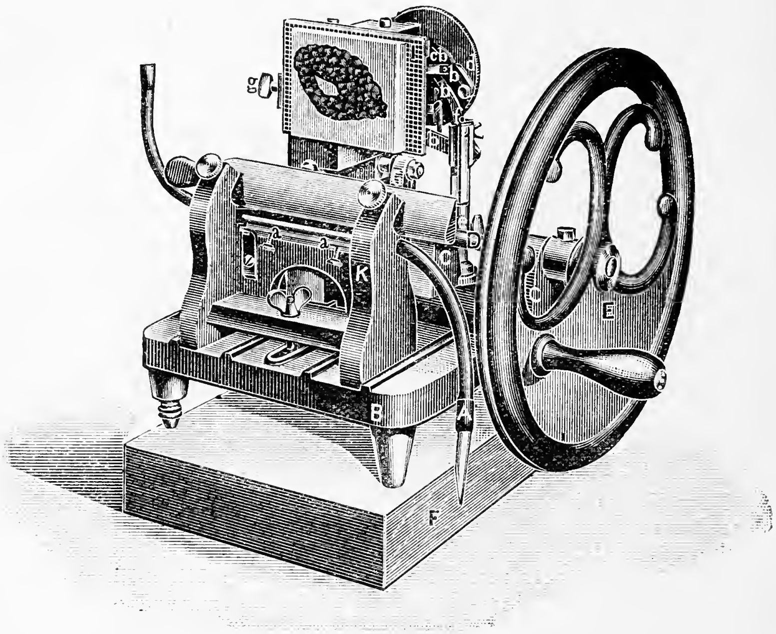
(3) Cutting, including Imbedding and Microtomes.

New Large Model Zimmermann Microtome.†—Dr. van Walsen describes this instrument, which has been constructed especially for the cutting of such large objects as brain-hemispheres. As will be seen from figs. 63, 64, it closely resembles the well known Minot-Zimmermann type. The cast-iron base-plate B is 24 by 30 cm., and on its right hinder quadrant are two short vertical pillars C C, in whose upper portion a horizontal axis D is inserted. The axis is operated by the wheel E, whose scollops are necessary in order to attain the requisite balance. The working is delightfully regular and easy, in spite of the rather great weight (33 kg.). The size of the wheel renders it necessary to set the machine either on the edge of a table or on a specially made wooden block (as in fig. 64). At its left end the horizontal axis is connected with the excentric lever G, whereby the rotation of the wheel produces a vertical movement of that part of the instrument which carries the object and the screw-adjustment. G has a groove parallel to its length (fig. 64), in which the small horizontal arm can

* Lancet, 1899, i. pp. 370-1.
† Zeitschr. f. wiss. Mikr., xiv. (1898) pp. 145–55 (2 figs. and 1 pl.).

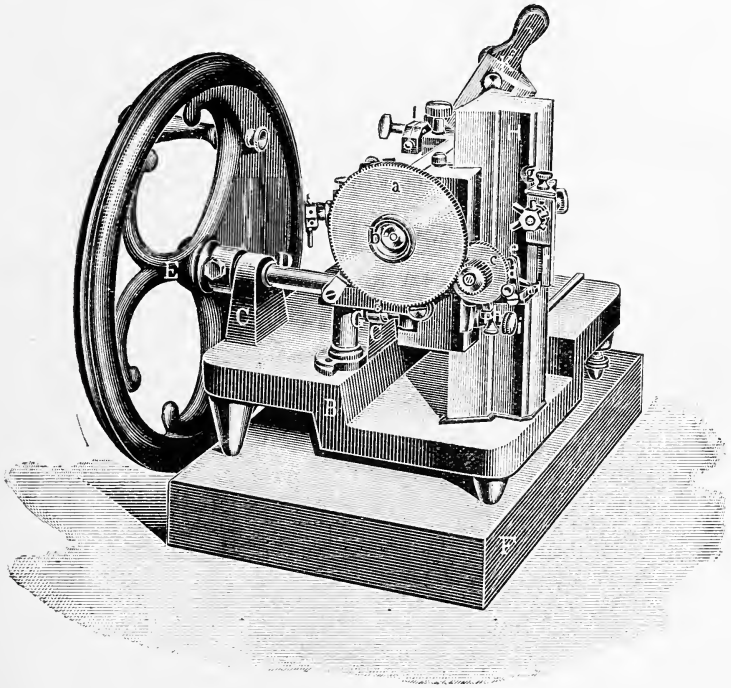
be fixed in any desired spot by means of the screw (visible in fig. 64). The adjustment can be read off by the millimetre graduations marked on the lever. In this way the movements of the slide can be reduced, if desired, and the instrument adapted to smaller sections without the consumption of much time. Object-tables are supplied in various sizes, the largest being 13 by 10 cm. I, in fig. 63, shows the largest size table, and in fig. 64 a smaller one. The upper surfaces of the tables are divided by millimetre-broad streaks into 2 by 2 mm. squares, useful not only for strong attachment of the paraffin blocks, but also for their shaping. The screws partly visible in fig. 64 effect the adjustment of the object by rotation about three principal axes. The application of the knife

Fig. 63.



to the object can be done in rough adjustment either by pushing the object-table along a horizontal axis or by pushing the knife-holder. The final application requires the micrometer-screw. Three knife-holders are supplied; two for paraffin (K, fig. 63); one for celloidin (K, fig. 64). On the base-plate are on each side two grooves, which render impossible any deviation of the knife sideways or backwards. The knife-holder has a movement from front to rear of 8·5 cm., and can be fixed in any position on the base-plate by means of the screw visible in fig. 64. A caoutchouc tube A, whose purpose is to regulate the temperature of the knife and local section, runs along the knife-back, and is approximated to the knife, as required, by the screws *a*, *a*. The advantage of a rise in the local section temperature is that ribbon-formation is facilitated, that section thickness can be varied within rather wide limits, and that resistance to the knife-action is reduced. Steam or hot water may be employed as the heat agent; and attachment can be made to a reservoir of constant pressure or temperature. Great attention has been bestowed on the means of the automatic propulsion of the preparation. The upper arm of a jointed lever *b*, *b*, *b*, *b* bears on its left end a catch which engages with the small toothed wheel *c* (fig. 63). The wheel is connected with the micrometer-screw, and serves the relatively rougher advance of the preparations. A stroke of the coarse adjustment corresponds to an advance of the preparation

FIG. 64.



of about 1/150 mm., as the micrometer-screw has a pitch of 1/2 mm., and the wheel 75 teeth. The movements of the lever are occasioned by the impact against the pins of a star block connected with a vertical pillar *e* (fig. 64). According to the position of the star, the wheel is advanced 1, 2, 3, 4, 5, 6, 9, 12, or 15 teeth, which correspond to the advance of the preparation of 6, 13, 20, 26, 33, 40, 60, 80, and 100 μ. The reading-off of the adjustment is by a millimetre scale whose indicator is visible to the right below *f* in fig. 64. The upper triangular part of the pillar is rotary, and is movable in the lower circular part, so as to put the parts out of action (as in fig. 64). The object can be fixed on any desired position of the slide by means of the screw *g*.

The knob *h*, with the wheels *a* and *c*, constitute the fine adjustment. The knob *h* indicates whole or half mikrons, and another screw *b* unites the wheel *a* with the micrometer-screw. The connection between the two wheels *a* and *c* can be raised, and the latter afterwards depressed; the screw *i* serves for fixing it. Photographs of some of the sections obtained accompany the description.

Rapid Method of Paraffin Imbedding.* — Dr. S. H. Champlin's method is as follows. A piece of fresh tissue the thickness of a thin or medium slide is suspended in absolute alcohol from 2–2¾ hours. It is then placed in benzol-cedarwood oil mixture until semi-transparent (usually from 10–30 minutes). It is next immersed in melted paraffin heated to between 47° and 50° C. This paraffin is a mixture of one part hard paraffin (50° C.) and two parts soft paraffin (40° C.) After the bath, which takes from 5–30 minutes, the specimen is imbedded in melted paraffin (two parts hard and one part soft paraffin) and allowed to cool slowly until semi-solid, when it should be rapidly cooled in ice water. The sections are fixed to the slide with Mayer's albumen mixture; passed through benzine and 90 per cent. alcohol; stained with China blue or bleu de Lyon, and afterwards with safranin; and mounted in balsam.

The safranin solution is made by adding 1 part of 40 per cent. formalin to 4 parts of saturated aqueous solution of safranin.

The entire process can be carried out in 3½–4 hours.

(4) Staining and Injecting.

Three Staining and Mounting Methods.†—Elise Wolff gives the following modification of Weigert's fibrin and bacteria method. (1) The alcoholic solution of gentian-violet is mixed with a saturated aqueous solution of lithium carbonate instead of with anilin-water. The solution must be made fresh when required for use. For staining fibrin, two thirds of lithium carbonate solution and one-third gentian-violet solution are required. In this the preparations are immersed for 3 or 4 minutes, and then in the iodine solution for 1–1½ minutes. They are decolorised first in pure anilin and afterwards in anilin-xylol (2–1). The preparations are extremely permanent. For bacteria, one-third lithium carbonate solution and two-thirds staining solution are required. In this the preparations are stained 5 or 6 minutes, or longer.

Instead of gentian-violet, a saturated alcoholic solution of fuchsin may be used, but the staining time must be extended to quite 10 minutes. The authoress is accustomed to celloidin sections which are stuck on by Aubertin's method.‡

(2) A good nuclear staining for material hardened in Müller's fluid or Benda's solution (nitric-acid-bichromate of potash solution) is obtained by immersing the sections for 24 hours in very dilute Böhmer's hæmatoxylin. After this the sections (if the materials have been hardened in Müller) are immersed in another quantity of the same hæmatoxylin solution, to which so much 5 per cent. aqueous solution of oxalic acid

* Journ. Applied Microscopy, ii. (1899) pp. 229–30.
† Zeitschr. f. wiss. Mikr., xv. (1899) pp. 310–2.
‡ Cf. this Journal, 1897, p. 174.

is added as not to visibly alter the colour. Usually one drop of the acid to a Petri's capsuleful of solution is sufficient. After some minutes the sections may be washed in tap water. When the preparations have been fixed by Benda's method, caustic soda is used instead of oxalic acid.

(3) Though thionin is a very instructive staining reagent, it is capricious, and does not last well as a rule. This untoward event is due, the authoress thinks, to the mounting medium. Colophonium or Canada balsam, applied by heating a little piece in the flame and using it while hot, is advised; as by this device preparations will keep for at least a year without obvious alteration. Toluidin is also said to be a suitable medium for mounting sections stained with thionin.

Modification of Van Ermengem's Method for Staining Flagella.*—Dr. H. M. Gordon has stained the flagella of *Micrococcus melitensis* and *Bacillus pestis* by Pitfield's and Van Ermengem's methods, but the latter, with the following modifications, gives the best results. The reducing agent, i.e. the tannin and gallic acid solution, must be several weeks old. The specimens should be left double the prescribed time in the mordant, for from $1\frac{1}{2}$–3 minutes in the first silver solution, from 2–3 minutes in the reducing agent, and in the last silver solution until the film begins to darken. Sometimes good preparations are obtained by washing in distilled water between the baths, and sometimes it is advisable to reverse the order of the baths.

Modification of Pitfield's Method for Staining Flagella.†—Mr. R. Muir gives the following modification of Pitfield's method for staining flagella.

(A) The mordant. Filtered 10 per cent. aqueous solution of tannic acid, 10 ccm.; saturated aqueous solution of sublimate 5 ccm.; saturated aqueous solution of alum, 5 ccm.; Ziehl-Nielsen phenol-fuchsin, 5 ccm. The mixture is to be centrifuged or allowed to stand all night. The clear fluid is then pipetted off. It will keep for one or two weeks.

(B) The stain. Saturated aqueous solution of alum, 10 ccm.; saturated alcholic solution of gentian-violet, 2 ccm. The solution will keep for two or three days.

To stain the film, flood the surface with the mordant, heat until vapour arises, and allow to steam for about one minute. Wash in running water for about two minutes, and then dry over the flame. Flood the surface with the stain, heat, and wash as before.

If black stained preparations be preferred, treat with Gram's iodine solution for one minute, dry over the flame, and mount in balsam.

The advantages claimed for this method over Van Ermengem's are:—that it is more simple to work; that it forms very little precipitate on the film; and that the organisms and their flagella appear to retain their natural proportions.

Sudan iii. in Botanical Microtechnique.‡—Dr. L. Buscalioni has investigated the staining reactions of Sudan iii. on vegetable tissue. Sudan iii., or Biebrich scarlet, is a brick-red powder, insoluble in water and alkalies, soluble in alcohol, chloroform, ether, fatty and ethereal

* Lancet, 1899, i. pp. 688–9 (1 pl.).
† Journ. Pathol. and Bacteriol., v. (1898) pp. 374–6. Cf. this Journal, 1893. p. 133.
‡ Malpighia, xii. (1899) pp. 421–40; Bot. Centralbl., lxxvi. (1898) pp. 398–9.

oils, in xylol, and in boiling acetic acid. It is extremely soluble in sulphuric acid, but then turns a dark-green colour. It has long been employed as a stain for animal fat. The author has examined its reactions towards vegetable tissues, and states that it is excellent for cutin, suberin, resin, and wax, which it stains a deep red. Cellulose membranes, collenchyme, and mucous membranes are unaffected. Woody tissues either do not stain or assume a blue-violet hue, and occasionally (Orchideæ) a faint red. The contents of cells, nuclei, protoplasm, starch-granules, and tannin do not stain; but oil, resin, and the contents of laticiferous vessels stain bright red. Chlorophyll-grains are stained a faint red, though certain minute granules within the grains are deeply coloured (*Cycas*, &c.). The reaction to spore-membranes and pollen grains is variable.

Sudan iii. may be used alone or in conjunction with eau de Javelle. Preparations are permanent.

New Stain for Tubercle Bacilli.*—Dr. M. Dorset has discovered that Sudan iii. is a good stain for tubercle bacilli. The preparations, films, or sections are first treated with 80 per cent. alcoholic solution of Sudan iii. for 5 or more minutes; the excess of stain is removed with 70 per cent. alcohol, and the preparations contrast stained, if necessary, with methylen-blue.

Sudan iii. appears to be quite a specific and selective stain for tubercle bacilli. Even when smegma and tubercle bacilli are mixed together, the new stain picks out only the tubercle bacilli.

Method for Ripening Hæmatoxylin.†—Prof. H. F. Harris prepares a ripened solution of hæmatoxylin as follows. 1 grm. of hæmatoxylin crystals is dissolved in 10 grm. of absolute alcohol. 20 grm. of ammonium or potassium alum are dissolved by the aid of heat in 200 ccm. of distilled water. The two solutions are mixed at once or after 24 hours, and 0·5 grm. of mercuric (red or yellow) oxide is added; the mixture is heated to boiling and then quickly cooled. The liquid at once assumes a dark-red colour, and may be at once used for staining. Sometimes a precipitate occurs after a few days, but after filtration does not re-form to any extent. On account of its reducing property chloral was added to some of the staining fluid; after a year this was found to be free from precipitate.

Method for Staining Secondary Degeneration in Nervous System.‡—The most important defect of Marchi's method, says Herr Ch. K. Busch, is associated with the slight penetrating power of osmic acid, which often does not reach the deeper layers. This defect may be remedied by diluting the osmic acid solution with a solution of iodate of soda, which prevents the osmic acid from decomposing too quickly, and permits it to penetrate into the tissue. A preparation (1·12 cm. thick) hardened in formol is placed in a mixture of osmic acid 1, sodium iodate 3, distilled water 300, for 5 to 7 days; then alcohol of increasing strength.

* New York Med. Journ., lxix. (1899) pp. 148–9 (1 pl.).
† Micr. Bull., xv. (1898) p. 47.
‡ Neurol. Centralbl., xvii. (1898) p. 476. See Zeitschr. f. wiss. Mikr., xv. (1899) p. 373.

The sections show the same staining as is produced by Marchi's method, but the normal tissue is clearer, and in consequence the degenerated parts stand out more clearly, and are easily recognised with the naked eye.

New Blood Stain.*—Mr. L. H. Prince obtains excellent results from the following mixture:—Saturated solution of toluidin blue 24 parts; saturated solution of acid fuchsin 1 part; 2 per cent. solution of acid eosin 2 parts. The solutions are made with distilled water, and the ingredients mixed in the order given. Only the supernatant fluid is used. When fresh, the solution stains in 30–60 seconds, but after 10–12 weeks 5–7 minutes are required to get a good result. The films are better fixed by heat than by sublimate solution or by the alcohol-ether mixture.

Method for Staining Bacterial Capsules.†—Herr Kaufmann recommends the following procedure for staining capsules of bacteria.

Stain for some hours at a moderate temperature, or for 2 hours at 35°, with Loeffler's methylen-blue. Wash in water which has been made alkaline with a few drops of strong caustic potash or caustic soda. Carefully dry the preparation, and then treat with 0·5 per cent. nitrate of silver solution. Wash in alkali-water. Stain for 30 seconds in fuchsin solution (1 vol. saturated alcoholic solution to 20 vol. distilled water). Wash in alkalised water. Dry, and mount in balsam.

Occasionally, capsules may be stained if the silver nitrate be omitted; and 0·25 per cent. sulphate of copper solution acting for one minute also effects the staining of capsules, but there is no contrast. The important point in the process is the washing in alkalised water. The microbes treated were *Micrococcus tetragenus*, *Pneumococcus lanceolatus*, *Bacillus Pneumoniæ Friedlaender*, *Bacillus capsulatus* Pfeiffer, and *Bacillus Anthracis*. The advantages claimed for this method are (1) the contrast staining, the bacterial body being blue and the capsule red; (2) the permanence of the preparations.

Staining Gonorrhœal Secretion with Anilin Mixtures.‡—Herr Lanz gives the following mixture for staining *Gonococcus*. It is composed of thionin and fuchsin; the gonococci pick up the thionin, the cell-protoplasm the fuchsin, while the nuclei are stained with a mixture of the two. The solution must be made fresh each time. The solutions are saturated ones in 2 per cent. carbolic acid, and are mixed in the proportion of 4 thionin to 1 fuchsin. A quarter of a minute is usually sufficient for staining; the preparation is decolorised by washing in water.

Staining Nerve-tissue with Gold.§—Herr S. Apáthy has stained nervous tissue for some years by the following method. He has used gold compounds before and after the fixation of the tissue. In the first or fore-staining method, fresh tissue is placed in the dark in 1 per cent. solution of aurum chloratum flavum ($AuCl_4H + 4H_2O$) for 2–24 hours.

* Micr. Bull., xv. (1898) pp. 42-3.
† Hyg. Rundschau, 1898, No. 18. See Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) p. 32.
‡ Deutsch. med. Wochenschr., 1898, No. 40. See Centralbl. Bakt. u. Par. 1te Abt., xxv. (1899) p. 152.
§ Mittheil. a. d. Zool. Stat. zu Neapel, xii. (1897) pp. 495–748 (10 pls.).

The specimen is then transferred to 1 per cent. solution of formic acid for 24 hours. During this time the preparation must be exposed to the light, and for 6–8 hours to direct sunlight. The preparations are to be mounted in gummi syrup (gum dextrin) or in strong glycerin.

When the preparations are fixed, the following method is adopted. The objects are fixed in sublimate or sublimate-alcohol. The sublimate is removed by iodopotassic iodide solution, and then the objects are transferred to strong alcohol, after which they are immersed in the following solution of iodine 0·5 per cent., iodide of potassium 1 per cent. in 95 per cent. alcohol, until the solution becomes yellow. After all the iodopotassic iodide has been removed by absolute alcohol, the object is imbedded in the usual way, and series of sections made.

The sections on the slide are immersed in 1 per cent. solution of aurum chloratum flavum for 24 hours. The sections are next immersed in distilled water for a short time, and then placed in tubes filled with 1 per cent. formic acid for 24 hours. After removal the sections are washed in distilled water and mounted in glycerin or balsam.

(6) Miscellaneous.

Method for Restoring the Spiking of Anthrax.*—Mr. R. Muir has found that the "spiking" of *Bacillus Anthracis* may be restored by making a culture from an old non-spiking organism on freshly prepared blood-agar tubes, and incubating for 24 hours at 37° C. Subcultures from this in 10 per cent. gelatin-pepton are incubated for two days at 20°, and then show the spiking well.

Orienting very Small Objects.†—Dr. R. W. Hoffman gives a modification and improvement of Patten's method for orienting very small objects. Instead of paper the author uses strips of glass, about 2–2·5 cm. long and 0·5–0·75 cm. broad, upon which the objects are stuck, and employs Patten's adhesive as an imbedding mass. The collodion-clove-oil mixture is made by putting equal parts of collodion and clove oil into a wide-mouthed bottle and allowing it to stand for about 24 hours in an airy place. It is next treated with xylol, which produces a perfectly clear and yellowish substance. The chief advantage of this adhesive-imbedding medium is that orienting becomes easy, more especially if the object be well stained. The objects are placed in position with needles. If necessary fine lines are easily scratched on the glass.

Metal-Mixture for Adhering to Glass.‡—A metal-mixture which will adhere firmly to glass and can be used for soldering glass together is made by mixing 95 per cent. tin and 5 per cent. zinc. The melting-point of this alloy is about 200°. The glass is previously heated to this temperature, and then the mixture spread over by means of the soldering iron. An alloy of 9 parts tin and 1 part aluminium may be used for the same purpose; but it has the disadvantage of having a higher melting-point, viz. 390°.

Double Capsule fo Bacteriological Purposes.§—Herr A. Bau has devised a capsule which is intended to prevent the access of germs from

* Journ. Pathol. and Bacteriol., v. (1898) p. 374.
† Zeitschr. f. wiss. Mikr., xv. (1899) pp. 312–6. Cf. this Journal, 1894, p. 534.
‡ Internat. Patentbureau. See Zeitschr. f. angew. Mikr., iv. (1898) pp. 218–9.
§ Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 645–6 (1 fig.).

the outside. The capsule proper has a double rim, the intervening furrow or channel being intended for the closing material. The cover, which dips into the channel, has the edge bent down so as to more effectually prevent entrance of germs. Very much the same result would be attained by using three capsules of different diameters, the one of middle size being used as the cover.

Sensitive Litmus-Paper.*—According to Herr Sachs, in order to obtain a sensitive litmus-paper, it is necessary to remove the brown-violet pigment from the litmus; and he recommends that, after the litmus has been macerated for 12 hours in water, the strained fluid should be evaporated down in a water-bath to the weight of the litmus used. It is then to be diluted with three parts of 90 per cent. alcohol, and after having been acidulated with hydrochloric acid, to be allowed to stand for 48 hours. The azolitmin is then found as a brown sediment deposited on the bottom of the vessel, while the violet pigment remains dissolved in the alcoholic fluid. The precipitate is washed with acidulated water until the filtrate, tested with ammonia, gives a blue colour without a trace of violet. It is then dissolved in ammonia in the proportion of 1 to 3·5, neutralised, and used for saturating bibulous paper. To render this solution durable, 10 per cent. alcohol should be added.

Delicacy of the Biological Test for Arsenic.†—Dr. F. Abba highly recommends Gosio's test for arsenic. This test consists in growing *Penicillium brevicaule* in contiguity with a piece of the suspected substance. If arsenic be present, the odour of garlic soon becomes apparent. The test is not only delicate, but rapid, and has been used by the author for detecting the presence of arsenic in urine, paper, gas, and hides. The procedure is simple. Two or three pieces of potato with a hole in the middle are placed in a Petri's capsule. Into each hole is inserted a small piece of the suspected material (say a piece of hide or skin 1 cm. long by 0·5 cm. broad), and the whole sterilised for 20 minutes at 115° C. When cool, about 0·5 ccm. of water in which are suspended spores of *Penicillium brevicaule* is poured over the potato. The culture is kept at room temperature, and when opened in 24 hours, the characteristic smell of garlic is perceptible.

The result may be hastened by incubating at 37°; but in this case, and more especially if several examples are being tested at the same time, the atmosphere of the laboratory becomes so impregnated with the garlicky odour as to render it difficult to say from which capsule the smell proceeds. As an example of the delicacy of the test, the author states that he cut from the same skin two pieces, one 5 sq. cm. and the other 1 sq. mm. in area, and examined the former by Marsh's test and the latter by Gosio's. The chemical test failed, while the biological succeeded.

* Wiadom. Farmac.; Pharm. Zeitschr. Russl., 619. See Zeitschr. f. ang. Mikr., iv. (1898) p. 215.

† Centralbl. Bakt. u. Par., 2te Abt., iv. (1898) pp. 806-8.

PROCEEDINGS OF THE SOCIETY.

Meeting of the 15th of February, 1899, at 20 Hanover Square, The President (E. M. Nelson, Esq.) in the Chair.

The Minutes of the Meeting of the 18th of January last were read and confirmed, and were signed by the President.

The List of Donations to the Society was read, and the thanks of the Society were given to the Donors.

	From
An Old Microscope (No. 33) and a 1/4-in. Objective by Andrew Ross	*Messrs. W. Watson and Sons.*

The President said he had to call the attention of the Fellows to a very valuable present made to the Society by Messrs. Watson and Sons, being a beautifully made Ross Microscope complete (see p. 214). In 1841, the Society ordered three Microscopes of the best models then known, one by Messrs. Ross, one from Mr. Smith, and one from Mr. Powell. Those by Smith and Powell were in the Society's possession still; but the one by Ross was, most unfortunately for the Society, exchanged at a later date for one of more modern construction. This great loss of an original instrument had now been to a large extent remedied by this gift of Messrs. Watson. It would be noticed that it had a rotary foot; this was not, however, an original idea, but had been invented by Cuff in 1760, and had from time to time been re-invented. This Microscope was furnished with a short lever nose-piece, fine adjustment, and a rackwork rectangular movement. He was sure the Fellows present would join in passing a very hearty vote of thanks to Messrs. Watson and Sons for thinking of the Society in this way, and for the presentation of this very beautiful Microscope.

The vote of thanks was then put from the chair, and carried by acclamation.

Mr. Beck exhibited a very ingenious and compact reversible compressorium designed by Mr. Davis, the construction of which was illustrated by a coloured sectional diagram.

Dr. Tatham said that Messrs. Beck had kindly given him an opportunity of seeing this new instrument. It was made chiefly of ebonite, and therefore possessed the merit of comparative lightness, a quality not always found in compressoria, which were sometimes so heavy that they were clumsy to use. The compressorium before them, like most other productions of Messrs. Beck, was exceedingly well made, and in his opinion would be found a useful accessory by the naturalist.

Mr. Karop inquired if it was made so that the object could be compressed without removing the ebonite ends?

Mr. Beck said that the central portion of the ebonite was cut away so as to give room for the fingers to work the compressorium quite freely whilst on the stage of the Microscope.

The President said, from what he had seen of this compressorium, it appeared to be a very valuable piece of new apparatus which was likely to be much appreciated.

The thanks of the Society were voted to Mr. Beck for his exhibit.

Mr. Watson Baker exhibited one of Messrs. Watson and Sons' Van Heurck pattern Microscopes made so as to give a complete rotation to the stage. In other respects it was the same as the usual pattern. He also showed a new cover-glass clip devised by Mr. Pakes, of Guy's Hospital, for making blood-films for examination in cases of disease (see p. 227).

The President thought the alteration in the stage of this Microscope was a step in the right direction. Dr. Dallinger, when President of the Society, spoke of the great desirability of making the stage so that it could be completely rotated, and he believed this was also insisted upon by another President, Mr. Michael.

The Secretary said he had not seen the cover-glass clip before, and thought it likely to be of use, more especially as the technique of the blood was coming more and more into notice.

The thanks of the Society were voted to Mr. Watson Baker for these exhibits.

The President called attention to the Martin Microscope which was given to the Society last year, but which he had not then time carefully to examine. Since then he had done so, and came to the conclusion that, although it was undoubtedly evolved from Benjamin Martin's Microscope which was described in 1765, it certainly was not one of the original make. He thought it was a very good modern imitation of Martin's Microscope, made probably about 1850. It agreed with the drawing (see p. 213).

The President said he had received a letter from Mr. Keeley, of Philadelphia, which he read to the Meeting (see p. 188).

Mr. Keeley had sent, in addition to the photographs which had been handed round, a slide containing sections of these diatoms mounted on edge. This he had examined, and he was able to corroborate all that Mr. Keeley had said. With regard to the *Coscinodiscus* and the *Triceratium*, Mr. Morland was, he believed, the first to work out and correctly describe these structures; his results were published by him (the President), together with a photo print, in the Transactions of the now defunct Middlesex Natural History Society (Jan. 1889). Mr. Keeley's present observations quite confirmed these results. So far as he was aware, the account they had heard that night of the structures of *Heliopelta* and *Auliscus* was original. He was sure they would all give a hearty vote of thanks to Mr. Keeley for his interesting communications.

The following bibliography on this subject might be useful.

H. J. Slack. On *Eupodiscus Argus*. Monthly Micro. Journ., vol. viii. (1872) p. 256. (Erroneous bead theory—E. M. N.)

W. Prinz. Diatoms in Thin Rock Sections. R. M. S. Journ., ser. 2, vol. i. (1881) p. 507; and vol. ii. (1882) p. 246.

Dr. Van Ermengem. Diatoms in Jutland "Cement-stone." R. M. S. Journ., ser. 2, vol. iii. (1883) p. 411.

Dr. J. H. L. Flögel. Diatom Sections. R. M. S. Journ., ser. 2, vol. iv. (1884) pp. 505 and 665, pl. 8 to 11.

(Dr. Flögel's observations with regard to coarse structures were most valuable, but his "microscopy" was very defective, and his conclusions as to the nature of the fine structure were quite untrustworthy; his work appeared to have been done with a narrow cone.)

H. Morland. Diatom Structure. Q. M. C. Journ., ser. 2, vol. ii. (1886) p. 297.

J. Debey. Diatom Structure. Q. M. C. Journ., ser. 2, vol. ii. (1886) p. 308.

The thanks of the Meeting were unanimously voted to Mr. Keeley for his communication.

The President said, before he sat down, and whilst they were on the subject of diatoms, perhaps they would allow him to direct their attention to a very interesting discovery of Mr. Morland's with regard to the bracket which strengthens the "plate" in *Arachnoidiscus* (published in the paper just quoted). Mr. Morland found that this bracket was nothing more nor less than that which an engineer would call a bead-headed girder. Engineers, no doubt, thought that they had made a great discovery when they had invented the T girder and the bead-headed rail, but in truth these were only a copy of something that Nature had already accomplished in the strengthening girders of an *Arachnoidiscus*.

The President said that Mr. Curties had brought for exhibition some photomicrographs by Mr. W. C. Rowden, of 66 Warrington Road, Newcastle-on-Tyne. He hoped the Fellows would give them a careful examination, as they were excellent photomicrographs of critical images. The blow-fly's tongue and the *Eunotia* were very charming, and were perhaps the best examples he had seen. He was sorry to say that a great deal of the so-called critical photomicrography of the present day was anything but critical, for it was often the work of men who, while talking and writing glibly enough about critical images, had never even seen a critical image, much less had photographed one.

The Secretary said another paper had been received from Mr. Millett, being Part IV. of his series of papers on the Foraminifera of the Malay Archipelago. This paper, like those which preceded it, would be of great value for reference, but was too technical for reading *in extenso* at the meeting. It would therefore be taken as read, and printed in the Journal.

The thanks of the Meeting were voted to Mr. Millett for his communication.

The President read a paper descriptive of the Powell Iron Microscope, constructed by Hugh Powell in 1840, the instrument being exhibited in the room (see p. 209).

Mr. Vezey said he was sure the Fellows would agree with him that their best thanks were due to the President for his very interesting description of the old instrument before them. It was essentially one of the functions of the Society to record the facts and development in the history of the Microscope, and in this special work no one had done more valuable service than the President. Mr. Vezey ventured to throw out a suggestion that if it were possible, an exhibition should be held of historic Microscopes, showing the various stages of the development of the instrument. He thought that, while all microscopists were ready to acknowledge the immense improvements which instrument-makers had introduced into the modern forms of Microscopes, yet it would be found, on examining the old instruments, that there were many valuable ideas which had probably been lost sight of.

The vote of thanks was seconded by Mr. Michael, and carried unanimously.

The President thanked the Fellows for the kind way in which they had passed this vote of thanks. He hoped the Society would see its way to arrange for an exhibition of old Microscopes which would not only be of great interest, but might also lead to the discovery of some points of value which had been hitherto overlooked.

Mr. Julius Rheinberg read a paper in explanation of the chief features of the exhibition of multiple coloured illumination of objects arranged under about twenty-seven Microscopes in the room (see p. 142).

The President said he was sure they would all highly appreciate Mr. Rheinberg's kindness in giving them such an excellent demonstration of his method of coloured illumination, which he had done at some considerable personal inconvenience. They would remember that Mr. Rheinberg first brought this subject to their notice in a paper read before the Society in 1896 (see Journal of that year, p. 373). In that paper all the various applications of his new method of illumination were fully dealt with, and it would therefore be unnecessary for him to go over that ground again; therefore he did not propose to discuss the merits of this method in connection with the colour differentiation of structure in histological and other preparations, but he believed that one of the chief values of this new illumination was that it might make it possible to use a larger axial cone than heretofore.

Sometimes cases arose where, from the tenuity of the object and other causes, they were compelled to use less than a 3/4 cone, and thus ran the risk of manufacturing spurious diffractive effects and other false images; if then this new method made it possible to use the 3/4 cone in such cases, it would be a distinct gain.

The Gifford screen had already accomplished much in this direction.

This screen, as they were aware, had the F line for the centre of its band, and it was found, from the experiments which were carried out by Mr. Gifford and himself, that it was not possible to go higher up the spectrum into the blue without incurring a loss visually, although photographically something was gained. Now, if they could only combine the Gifford screen with this new method by making the peripheral portion a blue whose spectrum began at F, and the centre a green in which the spectrum ended at F, he believed an advantage would be secured. Some words of caution were however necessary about the selection of the colours; for if they chose two that were widely separated in the spectrum, they might exaggerate the effects of the residual chromatic aberrations in the objective they employed; this of course applied with more force to semi-apochromatics than to apochromats. Suppose, for instance, that they used a deep red for the centre and a blue for the periphery, with a semi-apochromat, it was more than likely that that objective would have a sensibly shorter focus for the blue rays than for the red; then if their object should be a diatom having fine structure above a coarse, it was not improbable that the image, under these circumstances, might be reversed, and the fine structure appear by focal adjustment to be beneath the coarse.

In photomicrography, Mr. Rheinberg's method would prove useful, for there were certain objects having different parts that required different exposures; some diatoms formed an excellent example of this, for it sometimes happened that a strong eye-spot would be so brightly illuminated as to quite blot out a finely perforated membrane lying above it; that is to say, the eye-spot would require a very short exposure, while the delicate membrane above it required a longer one. Now, with this method they were able to impart a yellow or orange tinge to the eye-spot, and so equalise the exposure throughout. He hoped that Mr. Rheinberg would continue his valuable investigations, and, now that he was a Fellow of their Society, communicate any further discoveries he might make at some future meeting.

The thanks of the Meeting were then, upon the motion of the President, cordially voted to Mr. Rheinberg, and to those opticians who had so kindly provided the Microscopes for the purpose of the exhibition.

The President announced that at the next Meeting Mr. Lewis Wright would give them an exhibition of his Lantern Microscope.

The following Instruments, Objects, &c., were exhibited:—

The Society:—Microscope by Jas. Smith.

The President:—Powell's Iron Microscope.

Messrs. R. and J. Beck:—New Reversible Compressorium, and coloured sectional diagram of the same.

Mr. C. L. Curties:—Photomicrographs by Mr. W. C. Rowden.

Messrs. Watson and Sons:—New Model of the Van Heurck Microscope; New Cover-glass Clip for making blood-films.

Mr. J. Rheinberg:—List of Objects shown by Multiple Coloured Illumination:—

	Objects Exhibited.		Objective used.	Disc placed.
	Low-Power Colour Illumination.			
1	Blue ground	Section of gill bone of carp ..	1 in.	In condenser carrier.
2	" "	Feather of humming-bird ..	"	"
3	Red on blue ground ..	Transv. sect. *Cidaris* spine ..	"	"
4	Olive-green ground ..	Human muscle	"	"
5	Red on olive-green ground.	Section of saw of saw-fish ..	"	"
6	Malachite green ground	Various diatoms (from Bori, Hungary)	"	"
7	Red on malachite green ground.	Skin of plaice	"	"
8	Violet ground	Hair of rat	"	"
9	Red ground	Camphor crystals	"	"
10	Blue on red ground ..	Fibres of Egyptian cotton ..	"	"
11	Green on red ground	Spiracle of larva	"	"
12	Red on white ground	Foraminifera from Adriatic Sea	"	"
13	Red and green halves on black ground.	Sponge, *Geodia*, Honduras ..	"	"
14	Blue and red quarters on black ground.	Japanese silk fabric: horizontal threads blue, vertical threads red.	"	"
15	Green on red ground	Rotifers	"	"
16	Black ground	Hydrozoid zoophyte showing tentacles fully extended.	"	"
	Composition Method Colour Illumination.			
17	Green to red on white	Transv. sect. bone of human humerus.	1/4 in.	"
18	" "	Tape-worm from duck, *Cysticercus cypriocinerea.*	"	"
19	" "	Various diatoms	1/6 in.	"
20	" "	Marine algæ, *Plocamium coccineum.*	"	"
	High-Power Colour Illumination.			
21	Red on blue ground ..	Saw-fish spine	Apoch. 1/3 in. Zeiss	Focal plane of objective.
22	Blue ground	Teased-out fibres of human muscle.	1/5 in. Beck (with correction collar).	Between two lowest lenses of objective.
23	Green ground	Acarus, *Oribata gracilis* ..	1/4 in. Beck (with correction collar).	Above objective in focal plane.
24	Red on white ground	Transv. sect. bone of human femur.	1/6 in. Beck	Do. do.
25	" "	Scales of butterfly, *Vanessa urticæ.*	D D Zeiss	Do. do.
	Double Image Colour Illumination.			
26	The red centre of disc has plane parallel surfaces; the green circumference is prismatic in form.	Diatoms. Two images are formed of each diatom, the red image showing scarcely any detail, the green image formed almost wholly of diffraction fans minus the central or dioptric ray, showing plenty of detail (partly incorrect).	A A Zeiss	Above objective in focal plane.
27	Own Microscope with changing illuminator.	Group of diatoms.		

New Fellow:—The following was elected an *Ordinary* Fellow of the Society:—Mr. Julius Rheinberg.

MEETING

HELD ON THE 15TH OF MARCH, 1899, AT 20 HANOVER SQUARE, W., THE PRESIDENT (E. M. NELSON, ESQ.) IN THE CHAIR.

The Minutes of the Meeting of 15th February last were read and confirmed, and were signed by the President.

The List of Donations to the Society, exclusive of exchanges and reprints, received since the last Meeting, was read, and the thanks of the Meeting were voted to the donors.

	From
Veley, V. H. and Lilian J., The Micro-Organism of Faulty Rum. (8vo, London, 1898)	*The Publisher.*
Slater, Chas., and Spitta, Edmund J., An Atlas of Bacteriology. (8vo, London, 1898)	*The Publishers.*
Cole, R. S., A Treatise on Photographic Optics. (8vo, London, 1899)	*The Publishers.*
Ewart, J. C., The Penicuik Experiments. (8vo, London, 1899)	*The Publishers.*
The Naturalist's Directory, 1899. (8vo, London, 1899)	*The Publisher.*

The President called attention to another donation (a fine example of Wilson's Screw Barrel Microscope), received from their Treasurer, Mr. Suffolk. This instrument was probably 150 years old, and would be a valuable addition to the Cabinet, and he asked the Meeting to give the Treasurer a very hearty vote of thanks for the donation. This was carried by acclamation.

The President said Mr. Curties had sent an old Microscope for exhibition. It was one made by Chevalier, of Paris, *circa* 1840, and was interesting as being one of the earliest Microscopes made after the introduction of achromatism, and it also appeared to be one of the last remnants of the box foot, a form of stand first adopted in 1704. He did not think that this instrument was nearly so well made as some of the old English instruments produced about the same time by Powell, Ross, and Smith.

The thanks of the Meeting were voted to Mr. Curties for his exhibit.

Mr. C. F. Rousselet said he had brought to the Meeting that evening a mounted slide of more than usual interest—being a specimen of the rare rotifer *Trochosphæra*. The first species of this remarkable genus of the Rotifera was originally found in 1859 in the ditches in some rice fields in the Philippine Islands by Prof. Semper, who described it in 1872. A translation of his paper was afterwards printed in the 'Monthly Microscopical Journal' for 1875. The organism was perfectly spherical, and was divided into two hemispheres by the ciliary wreath running round its equator, from which character it was named *Trochosphæra* *æquatorialis.* Staff-surgeon Gunson Thorpe subsequently found the same form in the Botanic Gardens at Brisbane. When on the China Station he went up the Yang-tze-kiang river a distance of about 200 miles, and there found another species of the same genus which had the wreath, not round the middle as before, but round the upper portion about where the Tropic of Cancer would be marked upon the globe, and on this account he gave it the specific name of *solstitialis.* It was again found in America in 1896—and also in 1898—by Dr. Kofoid and Mr. Jennings. Some specimens of the last-named find had been sent to Mr. Rousselet, and the specimen placed under the Microscope in the room was, he believed, the first of the genus ever seen in England. In addition to the specimen exhibited, Mr. Rousselet further illustrated his remarks by a drawing on the board, in which he showed the nervous system, and also the position of the cloaca, which Mr. Gunson Thorpe had considered to be on the ventral side, although in this he was possibly mistaken. (See p. 162.)

The thanks of the Society were unanimously voted to Mr. Rousselet for his interesting exhibit and description.

Mr. Lewis Wright then gave an exhibition of Microscope slides by means of his improved projection Microscope. He said that fourteen-and-a-half years ago he came to the Society with Mr. Newton, and showed what could be done at that time with the projection Microscope, and he hoped on the present occasion to show them what progress had been made meanwhile. He regretted to find that he should be unable to show them the best that could be done, because he was prevented from using the electric light by reason of the available current being insufficient for the purpose; he must therefore fall back upon the old lime light; and as this was what he had used on the former occasion, perhaps the comparison could be even better made as to real improvements in lantern microscopy, apart from merely better illumination. These improvements were several. In condensers, it had been found very much better to use a four-lens condenser, by which it was possible to practically abolish the spherical aberration. He had also learned from the President of the Society the necessity for regulating the cone according to the aperture of the objective. Then the fine adjustment had also been greatly improved and rendered steadier by the adoption of strengthening bars and a differential screw. There had of course been also great improvements in objectives since he exhibited before, and these were the more available because all the best lantern work was now done with eye-pieces, which had, however, for screen demonstration, to be much larger in field than the well-known projection eye-pieces of Zeiss. Another important improvement had also been made in the screen, which was covered with a thin coating of silver, this rendering it more highly reflective and greatly increasing the brilliancy of the pictures. A plain silvered surface would not answer, as the image could then only be seen by persons in front of the screen, but he had found that by having the surface minutely ribbed or striated in a vertical direction, the light was so reflected from it that persons sitting at the sides could see quite well. Mr. Wright then proceeded to show a large number of slides under various powers, using objectives from $2\frac{1}{2}$ in. to Reichert's 1/6 in., giving amplifications on the screen from about × 250 to × occasionally 6000.

At the conclusion of his exhibition Mr. Wright expressed a hope that, although unable to show what could really be done under high powers with the electric light, he had yet demonstrated that the instrument was capable of showing all that was necessary for the purposes of class room instruction.

The President was sure the Fellows of the Society would agree with him that they were greatly indebted to Mr. Wright for giving this very excellent demonstration. He had certainly shown what the capabilities of the lantern Microscope now were as compared with the best results obtained fourteen years ago. He had great pleasure in proposing a very hearty vote of thanks to Mr. Wright for the great trouble he had taken in bringing his apparatus to show them.

The thanks of the Meeting were unanimously voted.

The Secretary said they had received another paper from Mr. Millett, being Part V. of his series on the Foraminifera of the Malay Archipelago. Like those which had preceded it, this paper was too technical to be read to the Meeting, he therefore proposed that it be taken as read, and it would be printed in the Journal with the illustrations. There was also a paper by the President "On Coarse-Adjustment Rackwork," which would likewise be taken as read owing to the lateness of the hour.

The President said he wished to draw attention to the excellence of the shows which they had recently been having at the Meetings of the Society as compared with those which were possible fifty years ago. An old, and formerly very active Fellow of the Society, to whom he was mentioning the matter, gave him some idea of what used to be done in those days, and amongst other things told him that at one of their *soirées* he had removed the object from the stage in order to replace it by another, and a lady during the interval had looked through the instrument, and called another to come and see how lovely it was, remarking that it was just like the full moon!

It was announced that at the next Meeting a paper would be read by Dr. Lionel S. Beale, F.R.S., on the Bioplasm of man and the higher animals, and its influence on tissue-formation, action, and metabolism.

The following Instruments, Objects, &c., were exhibited:—

The Society:—An old Microscope by Wilson.

Mr. C. Curties (C. Baker):—A Microscope by Chas. Chevalier.

Mr. C. F. Rousselet:—A mounted specimen of *Trochosphæra solstitialis.*

New Fellows:—The following gentlemen were elected *Ordinary* Fellows of the Society:—Mr. Fredk. Howard Collins, Mr. F. Gleadow, Mr. John Heaton, Mr. Archibald G. Kidston-Hunter, Dr. Chas. Fredk. Knight, Dr. Harry Morell.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

JUNE 1899.

TRANSACTIONS OF THE SOCIETY.

V.—*Report on the Recent Foraminifera of the Malay Archipelago collected by Mr. A. Durrand, F.R.M.S.—Part IV.*

By Fortescue William Millett, F.R.M.S.

(*Read 15th February*, 1899.)

Plate IV.

ARENACEA.

Family ASTRORHIZIDÆ.

Sub-Family **Astrorhizinæ.**

Pelosina Brady.

Pelosina rotundata Brady, plate IV. fig. 1.

Pelosina rotundata, Brady, 1878. Quart. Journ. Micr. Sci., vol. xix. n.s. p. 31, pl. iii. figs. 4, 5. *P. rotundata* Brady, 1884, Chall. Rept., p. 236, pl. xxv. figs. 18–20. *P. rotundata* (Brady) Egger, 1893,

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EXPLANATION OF PLATE IV.

Fig. 1.—*Pelosina rotundata* Brady. × 60.
„ 1, *b*. „ „ The same specimen laid open.
„ 2.—*Crithionina mamilla* Goës. × 40.
„ 2, *b*. „ „ The same specimen laid open.
„ 3. „ *pisum* Goës. × 40.
„ 4.—*Technitella legumen* Norman var. × 75.
„ 5, 6.—*Aschemonella catenata* Norman sp. × 90.
„ 7.—(?) *Jaculella* or *Rhabdammina*. × 40.
„ 8.—*Reophax difflugiformis* Brady var. *lagenarium* Bertholin. × 90.
„ 9. „ *ampullacea* Brady. × 70.
„ 10, 10* „ *pleurostomelloides* sp. n. × 135.
„ 11. „ *fusiformis* Williamson sp. × 40.
„ 12. „ *bacillaris* Brady. × 60.
„ 13. „ *Scottii* Chaster. × 75.
„ 14. „ *membranacea* Brady. × 75.

Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 254, pl. xi. figs. 59, 60.

The solitary specimen, from Station 6, resembles that figured by Egger, being more fusiform than the 'Challenger' examples. The shell-wall is very thick and the internal cavity small. It is essentially a deep-water species.

'Challenger' Stations are: in the North Atlantic, south of Rockall Bank, and west of the Azores; in the South Atlantic, south of Pernambuco; and at a single Station in the North Pacific. Reported by Egger from West Australia.

Sub-Family **Saccammininæ.**

Crithionina Goës.

Crithionina mamilla Goës, plate IV. fig. 2.

Crithionina mamilla Goës, 1894, Kongl. Svenska Vet.-Akad. Handl., vol. xxv. p. 15, pl. iii. figs. 34–36.

The specimens are all free, with the form symmetrical. The walls are very thick, and the cavity irregular in shape, smooth and polished. It is not abundant, but occurs at several of the Malay Stations.

Found by Goës at Koster Island, in the Skagerack; 106 metres.

Crithionina pisum Goës, plate IV. fig. 3.

Crithionina pisum Goës, 1896, Bull. Mus. Comp. Zool. Harvard College, vol. xxix. No. 1, p. 24, pl. ii. figs. 1, 2.

A few of the specimens may be assigned to this species, the shell-wall being much thinner and the cavity larger and not so smooth as in *C. mamilla.* It occurs at the same Stations as the latter, but is more rare.

Goës quotes it from the Gulf of Mexico; 940 fathoms.

Whilst engaged in writing these lines, there reaches me an announcement of the death of Dr. Goës. In a letter dated 27th May, 1896, referring to his last-named work, he writes, "my small essay, very probably the last of that line during my remaining life." This unfortunately proved prophetic. Although he had relinquished the study of the Foraminifera, his loss will be deplored by all Rhizopodists. A genial correspondent, he was always ready to advise and impart information to his fellow-workers. Painstaking as well as acute in his observations, his writings will endure as a lasting monument of work well and faithfully rendered.

In grateful remembrance of many kindnesses received from him, I cannot let this opportunity pass without offering a sincere tribute to his memory.

Sub-Family **Pilulininæ.**

Technitella Norman.

Technitella legumen Norman, plate IV. fig. 4.

T. legumen Norman, 1878, Ann. and Mag. Nat. Hist., ser. 5, vol. i. p. 279, pl. xvi. figs. 3, 4. *T. legumen* (Norman) Goës, 1894, Kongl. Svenska Vet.-Akad. Handl., vol. xxv. p. 14, pl. iii. figs. 20–27.

Much has been written on the subject of the powers possessed by the Foraminifera of selecting not only the material for the construction of their test, but also the size and form of the different particles. Typically, the test of *Technitella* should be a dense mass of spicules felted together and mixed with fine grains of sand, as is well shown in the figures by Goës. In all the Malay Archipelago specimens the test is constructed on a different plan, being simply a single layer of spicules cemented together side by side in parallel series, forming patches in which the direction of the spicules with regard to the axis of the test varies in different portions of the shell. The Marquis de Folin has figured numerous interesting examples of this form of construction, and has assigned to them the generic names of *Dioxeia*, *Trioxeia*, *Rhabdaminella*, and *Hyperaminella*. The affinity of this form with *Reophax* is very close, and is especially apparent when considered in relation to specimens of *R. ampullacea*, formed of thin laminæ, which occur in its company. In the Malay specimens the test is slightly compressed, and the general colour a light reddish brown.

It is found abundantly at several Stations in both Areas.

Sub-Family **Saccammininæ.**

Psammosphæra Schulze.

Psammosphæra fusca F. E. Schulze.

P. fusca Schulze, 1875, II. Jahresb. Komm. Untersuch. deutsch. Meere in Kiel, p. 113, pl. ii. fig. 8. *P. fusca* (Schulze) Haeusler, 1883, Neues Jahrbuch für Min., vol. i. p. 57, pl. iii. fig. 1. *P.* (Indet.) de Folin, 1887, Le Naturaliste, p. 127, fig. 13. *P. fusca* (Schulze) de Folin, 1888, Ibid., p. 110, figs. 4, 5. *P. fusca* (Schulze) Haeusler, 1890, Abhandl. schweiz. paläont. Gesell., vol. xvii. p. 15, pl. i. figs. 1–3. *P. fusca* (Schulze) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 14, pl. iii. fig. 19. *P. fusca* (Schulze) Grzybowski, 1896, Rozpr. Wydz. mat.-przy. Akad. Umiej w. Krakowic, vol. xxx. p. 274, pl. viii. fig. 14.

The specimens as usual vary considerably in size, but in all the test is composed of minute grains of sand.

It is very generally distributed in both Areas.

Sub-Family **Rhabdammininæ.**

Aschemonella Brady.

Aschemonella catenata Norman sp., plate IV. figs. 5, 6.

Astrorhiza catenata Norman, 1876, Proc. Roy. Soc., vol. xxv. p. 213. *Astrorhiza catenata* (Norman) Brady, 1879, Quart. Journ. Micr. Sci., vol. xix. n.s., p. 42, pl. iv. figs. 12, 13. *Aschemonella scabra* Brady, Ibid., p. 44, pl. iii. figs. 6, 7. *Aschemonella catenata* (Norman) Brady, 1884, Chall. Rept., p. 271, pl. xxvii. figs. 1–11, and pl. xxvii. A, figs. 1–3. ? *Reophax armatus* Goës, 1896, Bull. Mus. Comp. Zool. Harvard Coll., vol. xxix. p. 29, pl. i. fig. 1.

Of this very variable deep-water species two specimens occur from Station 6. They partake of the characters of the form first described by Brady as *A. scabra*, the test being void of spicules and characteristically thin. To the other form, which in 1879 Brady ascribed to *Astrorhiza catenata*, may probably be assigned the *Reophax armatus* of Goës, both of them having the test largely composed of spicules. Goës found the species in the Pacific, 1879 fathoms (one example only), and at 463 fathoms in the Caribbean Sea.

To this sub-family, and probably to the genus *Jaculella*, belongs a neat tapering cylindrical form without segments, of which there are several fragments, one of which is represented by pl. IV. fig. 7. The test is extremely thin, composed of sand-grains neatly fitted together and cemented after the fashion of a mosaic. Sometimes the test is curved.

Family LITUOLIDÆ.

Sub-Family **Lituolinæ.**

Reophax Montfort.

Reophax difflugiformis Brady.

R. difflugiformis Brady, 1879, Quart. Journ. Micr. Sci., vol. xix. n.s., p. 51, pl. iv. fig. 3. *R. difflugiformis* (Brady) Haeusler, 1885, Neues Jahrb. für Min., Beil.-Bd. iv. Heft 1, p. 9, pl. i. fig. 1. *R. difflugiformis* (Brady) Ibid., 1890, Abhandl. schweiz. paläont. Gesell., vol. xvii. p. 26, pl. iii. figs. 1–3 and pl. v. figs. 25–27. *R. difflugiformis* (Brady) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 26, pl. vi. figs. 196–198. *R. difflugiformis* (Brady) Chapman, 1895, Ann. and Mag. Nat. Hist., ser. 6, vol. xvi. p. 313, pl. xi. fig. 1.

The typical form with globose body and distinct neck, is but poorly represented both in size and number, although it is found at several Stations in both Areas.

Reophax difflugiformis var. *lagenarium* Berthelin, plate IV. fig. 8.

Haplophragmium lagenarium Berthelin, 1880, Mém. Soc. Géol. Fr., ser. 3, vol. i. p. 21, pl. xxiv. fig. 2. *Reophax difflugiformis* Brady, 1884, Chall. Rept., p. 289, pl. xxx. figs. 1, 5.

This variety, which tapers regularly from the base to the apex without a distinct neck, is so persistent, both geologically and geographically, that it seems worthy of being treated separately. It is rather more abundant than the type, and occurs at the same Stations. The test is usually of a looser structure than that of the globose form.

Reophax ampullacea Brady, plate IV. fig. 9.

R. ampullacea Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 49. *R. ampullacea* (Brady) Chapman, 1892, Journ. R. Micr. Soc., p. 320, pl. v. fig. 2.

In all the specimens the shell-wall is very thin, being composed of little more than a single layer of broad flakes from the shells of Mollusca and other organisms, cemented together at or near their edges. It is very abundant at several of the Stations.

Elsewhere the species is of extreme rarity, the only 'Challenger' Station being off Christmas Harbour, Kerguelen Islands, 120 fathoms. Chapman records it from the Gault of Folkestone, and says, "It occurs frequently in one stratum only, in zone xi., 12 ft. from the top."

Reophax pleurostomelloides sp. n., plate IV. figs. 10 and 10*.

Test free, monothalamous, oval; shell-wall thin and finely arenaceous; aperture a large crescent-shaped opening in a lateral depression of the test near the apex. Length, 0·20 mm.

This is an interesting isomorph of the genus *Pleurostomella.* The lateral depression varies considerably in size, sometimes occupying but a small space near the apex, at other times reaching almost to the base of the shell. Being monothalamous, with a single aperture, this species is assigned provisionally to the genus *Reophax,* from which, however, it differs in not having the aperture terminal. In regarding such forms as this and *Nubecularia dubia,* it must be felt that, in the absence of any knowledge of the character of the cell-contents, great uncertainty must exist as to their real position in nature.

It is not very abundant, but is found at several Stations in both Areas.

Reophax fusiformis Williamson sp., plate IV. fig. 11.

Proteonina fusiformis Williamson, 1858, Rec. For. Gt. Br., p. 1, pl. i. fig. 1. *Reophax fusiformis* (Will.) Brady, 1884, Chall. Rept., p. 290, pl. xxx. figs. 7–11. *R. fusiformis* (Will.) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 217, pl. xli. fig. 18. *R. fusiformis* (Will.?) Haeusler, 1890, Abhandl. schweiz. paläont.

Gesell., vol. xvii. p. 27, pl. v. fig. 22. *R. fusiformis* (Will.) Chapman, 1892, Journ. R. Micr. Soc., p. 320, pl. v. fig. 3.

The specimens are large, and the test is formed of very coarse grains of sand; most of them have the small initial chamber which marks the transition to *R. scorpiurus*. It is tolerably plentiful, but the range is rather restricted.

Reophax scorpiurus Montfort.

R. scorpiurus Montfort, 1808, Conch. Syst., vol. i. p. 331, 83e genre. *R. scorpiurus* (Montf.) Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. (Sci.) p. 328, pl. xiii. fig. 5. *R. scorpiurus* (Montf.) Haeusler, 1885, Neues Jahrb. für Min., Beil.-Bd., iv. Heft 1, p. 9, pl. i. figs. 14, 15. *R. scorpiurus* (Montf.) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 217, pl. xli. fig. 10. *R. scorpiurus* (Montf.) Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. (Sci.) p. 328, pl. xiii. fig. 5. *R. scorpiurus* (Montf.) Haeusler, 1890, Abhandl. schweiz. paläont. Gesell., vol. xvii. p. 27, pl. v. figs. 23, 24. *R. scorpiurus* (Montf.) Chapman, 1892, Journ. R. Micr. Soc., p. 320, pl. v. figs. 4, 5. *R. scorpiurus* (Montf.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II., vol. xviii. p. 257, pl. iv. fig. 18 and pl. v. figs. 45, 46. *R. scorpiurus* (Montf.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 24, pl. v. figs. 158–169.

Most of the specimens have the test composed of rough grains of sand, but in a few it is built up of thin flakes derived from organisms of various kinds. The figures by Goës, above referred to, show well the relationship of this form with *R. fusiformis*.

It is common, and widely distributed.

Reophax bacillaris Brady, plate IV. fig. 12.

R. bacillaris Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 49. *R. bacillaris* Brady, 1894, Chall. Rept., p. 293, pl. xxx. figs. 23, 24. *R. bacillaris* (Brady) de Amicis, 1895, Naturalista Siciliana, anno xiv. p. 72, pl. i. fig. 17. *R. bacillaris* (Brady) Goës, 1896, Bull. Mus. Comp. Zool. Harvard Coll., vol. xxix. p. 27.

A rare deep-water species, represented by a very few examples from Stations 5 and 6. The specimens are, however, highly characteristic.

Found at only one 'Challenger' Station, on the north coast of Papua, 1070 fathoms. Goës reports it from the Pacific, 1132–1201 fathoms.

Reophax dentaliniformis Brady.

R. dentaliniformis Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 49. *R. dentaliniformis* Brady, 1884, Chall. Rept., p. 293, pl. xxx. figs. 21, 22. *R. dentaliniformis* (Brady) Goës, 1894,

K. Svenska Vet.-Akad. Handl., vol. xxv. p. 25, pl. vi. figs. 172–175. *R. dentaliniformis* (Brady) Goës, 1896, Bull. Mus. Comp. Zool. Harvard Coll., vol. xxix. p. 27.

Another rare deep-water species, occurring a little more frequently than the preceding.

Recorded by Goës from the Skagerack, Baltic, Pacific, and Caribbean Sea.

Reophax Scottii Chaster, plate IV. fig. 13.

R. Scottii Chaster, 1892, First Rep. of the Southport Soc. of Nat. Sci., p. 57, pl. i. fig. 1.

A delicate flexible species which, when moist, can be bent into a curved or serpentine form, retaining the shape when dry. The *R. flexibilis* of Schlumberger, from the Russian Arctic Seas,* has precisely the same character, and closely resembles this form in other respects.

It has been recorded from Scotland, Ireland, and Malta, as well as from the Southport district. In the Malay Archipelago it is very rare.

Reophax membranacea Brady, plate IV. fig. 14.

R. membranacea Brady, 1879, Quart. Journ. Micr. Sci., vol. xxix. n.s., p. 53, pl. iv. fig. 9.

The examples of this species are few and fragmentary. None of them show the transverse wrinkles mentioned by Brady, and the form of the chambers indicates an affinity with *R. Scottii.*

It occurs at a few Stations, but is very rare.

* Mém. Soc. Zool. France, vol. vii. 1894, p. 258, pl. iii. fig. 10.

VI.—*The Rackwork Coarse-Adjustment.*

By Edward M. Nelson, Pres. R.M.S.

(*Taken as read, March 15th,* 1899.)

A Microscope not fitted with a rackwork coarse-adjustment makes only an indifferent instrument, and one which in this country is rapidly disappearing from the Microscope world. The quality of the coarse-adjustment is an important point in a Microscope, and the microscopist will appreciate this importance more and more as his technical skill in the manipulation of the instrument improves. A tyro nervously brings his low-power objective by means of the rackwork coarse-adjustment to within 1/8 of an inch of the focus, and then finishes up with the fine-adjustment, whereas an expert microscopist would not use the fine-adjustment at all in finding the focus of even the widest angled high-power oil-immersion.

After the focus has been found, a beginner will use his fine-adjustment in the examination of objects with low powers, while an expert would depend solely on the rackwork coarse-adjustment for work with medium powers, such as 2/3, 1/2, 4/10 and 1/3 objectives; consequently, it becomes a matter of importance in the construction of a Microscope that the rackwork coarse-adjustment should be of first-rate quality.

History.

Rackwork was first applied to the coarse-adjustment of the Microscope by P. Bonannus in 1691; this, as might have been expected, was of a very crude type (fig. 65), reminding one more of the machinery

Fig. 65.

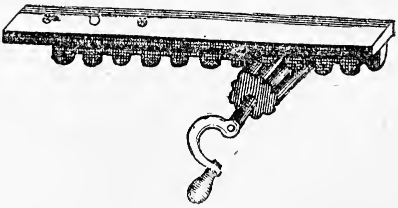
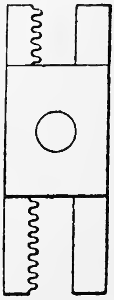


Fig. 66.



used for opening and closing the sluice of a canal lock than the coarse-adjustment of a Microscope.

We find no improvement in the rackwork until Benjamin Martin, 1765–1770, introduced the plan of cutting the teeth of the rack in a slotted bar (fig. 66). The rack was placed on the inside of the slot, in order that the inside of the plain bar opposite the rack might give a smooth sliding surface for the bearing. He afterwards improved this plan by fixing the slotted bar to a stout post; this would give more stability, the slotted bar probably proving too weak for the work it was intended to do.

In the large Benjamin Martin Microscope (1780), in the Society's cabinet, the slotted bar is attached to a *triangular* prism bar. This is specially interesting, because it is the first appearance of a triangular prism bar in the Microscope. In 1771, G. Adams brought out his "Variable" Microscope; this very interesting model had a rackwork coarse-adjustment of a rough type, scarcely equal in efficiency to Benjamin Martin's slotted bar. The slotted bar attached to a stout *rectangular* bar was a favourite form of coarse-adjustment at the close of the last and the opening of this century; it was largely used by Adams and Jones; but it should be remembered that these Microscopes, with the exception of the "Variable," were stage focussers.

The next improvement in the coarse-adjustment was designed by Dr. Goring, and is to be found in his "Operative Aplanatic Engiscope," made by Andrew Pritchard (May 1829).* This instrument is a body focusser; an equilateral triangular bar, to which a transverse limb carrying the body is attached, racks out of a cylindrical rod. The triangular bar has a groove placed in one of its sides, into which is brazed a strip of brass with a rack cut on it, thus forming what may be called a sunk rack. The bearing of the pinion which actuates this rack is seen in fig. 67; it should be particularly noticed that springs were placed above and below the pinion, to bear on the triangular bar on the same side as the rack. This Microscope had, therefore, a coarse-adjustment far in advance of any that preceded it. About this time, Andrew Pritchard made Microscopes on a less elaborate and more practical model than that of Dr. Goring's, but the coarse-adjustments were of a similar pattern to his. In March 1831, Mr. W. Valentine designed a Microscope, which was made by Andrew Ross; this had a coarse-adjustment on the same model. It is interesting to note, that Dr. Goring, in describing his Microscope, suggests the employment of a differential screw for a fine-adjustment.†

Fig. 67.

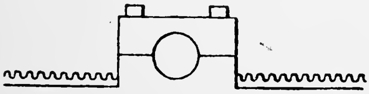
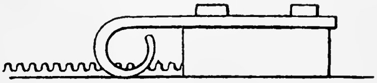


Fig. 68.



The next improvement we find is Cornelius Varley's "Vial Microscope," which was made by Hugh Powell in 1833.‡ The bar was square, and was sprung; the rack had 40 teeth to the inch, and

* 'Microscopic Illustrations,' 1st edition (1830), p. 52. † Loc. cit.

‡ Transactions Society of Arts, vol. l. part i. p. 166, pl. 5 (1836). Varley's Microscope was brought before the Society in the session 1833-34.

the pinion was mounted in a spring bearing (fig. 68). The springing of the pinion was a great advance, and made this the best coarse-adjustment that had been applied to the Microscope up to that time. Varley drilled holes in the edge of the milled head of the coarse-adjustment, and fitted capstan bars to them for purposes of fine-adjustment.

A further improvement in the coarse-adjustment was made by Powell, in a Microscope having a wedge fine-adjustment fitted to the stage, which he brought before the Society of Arts in the Session 1834–35. In this Microscope an equilateral prism bar, with the angles much truncated, was substituted for the rectangular bar of Varley's "Vial" Microscope; the rack, with 22 teeth per inch, was attached to the posterior plane side of the bar, and was not sunk; the bar was also sprung.* A coarse-adjustment with a sprung pinion is found in J. Smith's Microscope with the Lister limb, purchased by the Society in 1841, and also in Edwin Quekett's Microscope, both of which are in the Society's cabinet. Edwin Quekett, who was one of the founders of this Society, presented his Microscope, which was partly made by his own hands. He died in 1847, aged thirty-nine.

We can pass on to 1861 before we find any further improvement in the coarse-adjustment; in this year Powell brought out his "No. 1," which, with the sole exception of the stage rotation, is the same as you now know it.† The improvement consisted in the shape of the bar, which was formed from an isosceles prism, having a base $1\frac{1}{2}$ in., and side $2\frac{1}{2}$, with $1\frac{3}{4}$ in. cut away from the apex, leaving a massive trapezoid bar with a base $1\frac{1}{2}$, top $1\frac{1}{8}$, and sides 7/10 in.

Having brought up the history of the coarse-adjustment to a recent date, it will be necessary, before proceeding further, to consider very briefly the theory of rack-and-pinion work.

Theory.

In rack-and-pinion work, such as we have in a coarse-adjustment, the pinion is termed the driver, and the rack the follower.

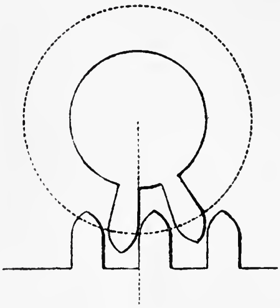
Let a perpendicular be dropped from the centre of the pinion to the rack (see dotted line in fig. 69). Now it is important that the teeth of the driver should only come into contact with those of the follower past this line towards the right hand, supposing the rack to be moving in a direction from left to right. The reason for this is, that all friction occurring past this line is called disengaging friction, which may be compared to that occasioned by a man walking on a pavement trailing his stick after him with the ferrule on the ground;

* Transactions Society of Arts, vol. l. part ii. p. 108, pl. 3 (1836). (Account of stage fine-adjustment only given; we know, however, from existing examples, the form of Microscope to which this stage was fitted.) Several of the plates illustrating the Microscopes were presented to the Society of Arts by Dr. R. H. Solly. Many of the plates relating to various kinds of machinery were drawn by C. Varley, and engraved by Edmund Turrell (the inventor of the well-known Microscope stage).

† Quarterly Journ. Micr. Sci., vol. i. N.S., 1861, p. 175, fig.

whereas contact before this line is called engaging friction, and may be likened to that encountered by a man pushing his stick before him, which is altogether a very different matter. The friction at the point where the dotted circle and the perpendicular cut one another, when the teeth are properly constructed, is rolling friction, and is very small.

Fig. 69.



The dotted circle, which cuts the perpendicular at the point of contact of the teeth, is called the pitch circle (fig. 69); the pitch of the pinion is the breadth of a tooth and interspace measured on that pitch circle, and the pitch of the rack is the width of a tooth and interspace.

In order that the best results may be obtained, the following conditions must be satisfied:—

1. The pitch of the pinion must be the same as that of the rack.

2. The roots of the teeth of the pinion must be hypocycloidal, and their points (the addenda, or portions beyond the pitch circle) must be epicycloidal.

3. The roots and addenda of the teeth of the rack must be cycloidal.

4. The diameters of the generating circular rollers of these cycloids must be the same, and may be equal to half the diameter of the pitch circle. (The hypocycloidal portions of the pinion teeth will, under this condition, be radii of the pitch circle.)

5. The pinion should have not less than twelve teeth.

6. The breadth of the teeth should be 5/11 of their pitch, and the width of the space between them 6/11 of their pitch, the back lash, or "loss of time," being therefore 1/11 of the pitch.

7. Depthing:—The distance from the point of the pinion tooth to the bottom of the space in the rack should be 1/10 of the pitch.

A rack-and-pinion, constructed on the above data, will form as perfect a mechanical movement as possible; but it should be noticed that "loss of time" is an essential condition of this perfection. If involute teeth are used, the pinion would require 25 teeth in order to minimise the engaging friction.

Practice.

It will be observed, that the sixth condition imposes a "loss of time" equal to 1/11 of the pitch; now "loss of time" in a coarse-adjustment is a veritable nightmare to a microscopist. Most microscopists care nothing about the mechanical perfection of their coarse-adjustments, the sole condition they impose on the maker is, that there should be no "loss of time."

We must therefore consider the various methods that are employed to get rid of this "loss of time." The first method, one that has been largely employed for the fifty years subsequent to 1829, the date of Goring's improvements, is to wholly disregard the shape of the teeth, their pitch and depthing, to select any pinion that will fit any rack, and then to force the teeth of the pinion into the rack by screwing up the top brass of the bearing. Figs. 70 and 71 show the kind of bearings fitted to Microscopes in order to carry out this method. In fig. 70 the faces of the brasses are cut away so as to leave space for the tightening of the screws, as the upper brass is worn down by the friction of the pinion, which friction, owing to the engaging friction of the teeth, must be considerable. In any case fig. 70 is but a poor makeshift, and altogether a rickety affair, because the brasses are not tightly faced up as in fig. 67. In fig. 71 a somewhat better makeshift

Fig. 70.

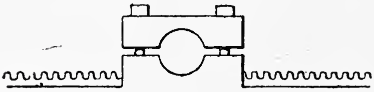
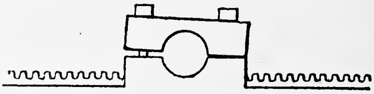


Fig. 71.



is seen, for the edges of one side of the bearing are brought together, thereby making a somewhat steadier bearing than that in fig. 70. In Microscopes made of hard brass these devices might succeed for a time, but, with the present fashionable soft brass Microscopes, in a very little while the brasses cut, and then there comes a speedy end to their freedom from "loss of time."

The second method, a far better one, is known as the "diagonal rack and twisted pinion." This was, I believe, introduced by Messrs. Swift and Son, about 1880, and is now universally adopted.*

The advantages gained by this method are due to the twist in the pinion being a shade steeper than the diagonal of the rack, by which simple expedient not only is "loss of time" prevented, but all necessity for unduly forcing the teeth of the pinion into those of the rack is obviated.

The bearings commonly used with diagonal rackwork are of the types shown in figs. 67, 70, and 71; but I got Powell to put diagonal rackwork to my Microscope (his No. 1) with such satisfactory results that he has permanently adopted it. Diagonal rackwork used in connection with his prism-bar and sprung-bearing, fig. 68, must be regarded as the highest type of coarse-adjustment at the present time.

There is one drawback to the employment of diagonal rackwork, viz. that it throws end-pressure on one side of the pinion; this in the Microscope is, however, a small matter.

* Journ. R.M.S., vol. i. ser. 2, 1881, p. 518, fig. 121. It has been said that the application of this method to the Microscope dates back to Andrew Pritchard's time; but this statement I am unable to verify.

The question now arises:—Is there any better form of rackwork possible? This, I believe, can be answered in the affirmative. The form that might be advantageously adopted is that known as a stepped rack (not of the diagonal but of the ordinary straight type). The various conditions enumerated above should be rigidly adhered to, but the number of teeth in the pinion might usefully be increased to fourteen. In stepped rackwork two parallel racks engage in the same pinion; one rack, however, is placed so that its teeth are stepped an amount equal to the "back lash" behind those of the other, i.e. 1/11 of the pitch.

The racks should be cut together, and fixed in the position they were cut. The object of this plan is that one of the racks shall be in action when the bar is racked up, the other when it is racked down; so, then, if the racks are properly placed relatively to one another, "loss of time" is simply an impossibility; and, be it observed, this desirable result is obtained without forcing the teeth of the pinion into those of the rack, and without increasing the engaging friction, provided that the shape of the teeth is true and the formula accurately followed. This plan would be well worth a trial.

Diagonal stepped rackwork was suggested by the late J. Mayall, Jun., who went so far as to propose three diagonal racks *; but it is doubtful if stepping diagonal rackwork is not rather disadvantageous than otherwise. It would seem that Mr. Mayall missed the point of the problem; for he stepped the pinions as well as the racks. In his three-rack system the teeth of the racks and pinions are displaced 1/3 of the pitch behind one another, and all the three pinions drive at the same time; this of course adds greatly to the strength of the mechanism, and it would be very serviceable in mill work, for example, in those cases where it was necessary to transmit great power with a small-sized pinion.

In the Microscope, however, the work to be done is light, and the strength of either the leaves of the pinions or the teeth of the rack does not enter into the question, as there can be no possible risk of stripping. The essence of the problem before us is how to get rid of "loss of time," and yet keep the amount of engaging friction at a minimum.

Now, engaging friction with a pinion of eight leaves is much greater than with a pinion of sixteen. By stepping two racks and two pinions of eight, you may obtain, by Mr. Mayall's plan, the strength of a pinion of sixteen, because you have doubled the number of teeth acting at the same time, but obviously you also largely increase the amount of engaging friction.

Now, as the strength of the material in ordinary Microscope constructions is ample for the work required, it goes without saying that the search after some method whereby the mechanism is to be

* Journ. R.M.S., vol. iv. ser. 2, 1884, p. 958, figs. 153, 154.

strengthened by the increase of engaging friction is simply labour lost. In my system, although there are two racks, only one of them is in action at a time, consequently there can be no increase of the engaging friction. I am not aware that stepped rackwork arranged in this manner has been applied to the Microscope before.

SYNOPSIS OF HISTORY.

Author.	Nature of Improvement.	Date.
P. Bonannus	Application of rackwork	1691
B. Martin	Rack in slotted bar	circa 1765
G. Adams	Body-focusser, ordinary rack, rectangular bar ..	1771
B. Martin	Body-focusser, one inch of rack in slot in tube (telescope form); example in Society's cabinet	circa 1776
B. Martin	Slotted bar attached to triangular prism; example in Society's cabinet	circa 1780
Dr. R. C. Goring ..	Body-focusser, triangular bar racking out of a cylindrical rod, bar sprung	1829
C. Varley	Square bar sprung, pinion sprung, rack 40 teeth per inch	1833
H. Powell	Equilateral prism bar with truncated angles, bar sprung, pinion sprung, rack 22 teeth per inch.	1834
H. Powell	Trapezoidal bar sprung, pinion sprung	1861
J. Swift	Diagonal rack and twisted pinion, bar sprung, pinion not sprung	1880
T. Powell	Application of diagonal rack and twisted pinion to trapezoidal bar, bar and pinion sprung ..	1893

OBITUARY.

Surgeon-Major George Charles Wallich, M.D., L.R.C.P. Edin.

We regret to have to record the death of Surgeon-Major G. C. Wallich, the oldest (with one exception) of our Honorary Fellows, he having been elected in 1872.

Although for some years Dr. Wallich had lived in retirement, his name was very familiar to naturalists and microscopists of an earlier generation, as one of the pioneers of deep-sea dredging, and one of the earliest to apply high microscopic powers to the study of the structure of the diatom-valve, fields in which so many have since worked. His activity in research during the period when he was able to devote his energies to microscopical work, may be gathered from the accompanying list of his more important contributions to scientific journals and other publications. He has also left a mass of unpublished manuscript in the possession of the Royal Microscopical Society, accompanied by very beautiful drawings.

Dr. George Charles Wallich was born on November 16th, 1815, at the Botanical Gardens, Calcutta, and was the eldest son of Nathaniel Wallich, M.D., Ph.D., F.R.S., Knight of the Danish Order of Dannebrog, and Superintendent of the Botanical Gardens, Garden Reach, Calcutta. He was educated at Beverley, Reading Grammar School, King's College, Aberdeen, and the University of Edinburgh, where he took his degree of M.D. in 1836, and became Licentiate of the Royal College of Surgeons, Edinburgh, in 1837. In 1851 he married Caroline Elizabeth Norton, daughter of Edmund Norton, of Lowestoft, solicitor.

Dr. Wallich entered Her Majesty's Indian Army in May 1838. He served as Assistant Superintending Surgeon in the Sutlej Campaign of 1842, obtaining a medal; throughout the Punjaub Campaign of 1847, with the 2nd Irregular Cavalry in Brigadier Wheeler's force, again obtaining a medal; and in the Sonthal Campaign as Field Surgeon, in 1855, 1856. He was invalided home early in 1857. In 1859 he settled in Guernsey, and subsequently at Kensington.

In 1860, hearing that an expedition was about to be sent out in connection with the survey of the line for the North Atlantic Telegraph route between Great Britain and America, *viâ* Shetland, Faroe Isles, Iceland, and Greenland, Dr. Wallich volunteered to accompany the expedition as Naturalist. His offer was accepted, and on the 22nd of June, 1860, he sailed from Spithead, in H.M.S. 'Bulldog,' under the command of Sir F. Leopold McClintock, returning to London in November of the same year.

In 1872, as stated, Dr. Wallich was elected an Honorary Fellow of the Royal Microscopical Society; he was a Corresponding Member of the Royal Society of Liège; and in 1898 the Linnean Society of London awarded him its gold medal in recognition of his researches into the problems connected with bathybial and pelagic life. He died on March 31st, 1899, at Nottingham Place, Marylebone, London, in the eighty-fourth year of his age.

List of Contributions to Scientific Literature by Surgeon-Major Wallich, M.D.

1. On *Triceratium*, *Hydrosera*, &c. Micros. Journ., 1858.
2. Microscopic objects collected in India. Do., 1858.
3. Siliceous organisms in stomach of *Salpæ*, &c. Do., 1859.
4. Apparatus for dredging and skimming at sea. Do., 1859.
5. Desmidiaceæ of Bengal. Ann. Mag. Nat. Hist., 1860.
6. Development and structure of diatom-valve. Trans. Micr. Soc., 1860.
7. Markings of Diatomaceæ as test-objects. Ann. Mag. Nat. Hist., 1860.
8. Habits of freshwater and pelagic diatoms, &c. Do., 1860.
9. Notes on the presence of animal life at great depths. Pamphlet, 1860.
10. Presence of animal life at great depths. Ann. Mag. Nat. Hist., 1860.
11. Lecture on the same subject at Royal Institution. Journ. R.I., 1861.
12. Novel phases of animal life at great depths. Ann. Mag. Nat. Hist., 1861.
13. New method of making sections. Do., 1861.
14. The North Atlantic sea-bed. 1 vol. 155 pp., 1862.
15. Further observations on novel phases, &c. Ann. Mag. Nat. Hist., 1862.
16. The North Atlantic sea-bed and its inhabitants. Intellectual Observer, 1862.
17. An undescribed indigenous *Amœba*. Ann. Mag. Nat. Hist., 1863.
18. Further observations on *Amœba villosa*. Do., 1863.
19. Observations on amœban Rhizopods. Do., 1863.
20. Value of distinctive characters in *Amœba*. Do., 1863.
21. Further observations on do. Do., 1863.
22. Structure of the valves of *Pleurosigma*. Do., 1863.
23. Mineral deposit in Rhizopods and Sponges. Do., 1864.
24. Extent and causes of the structural variation in *Difflugia*. Do., 1864.
25. Structure and affinities of Polycystinæ. Trans. Micr. Soc., 1864.
26. Coccoliths and Coccospheres. Ann. Mag. Nat. Hist., 1868.
27. *Physalia* and certain Scomberoid fishes. Do., 1869.
28. Structure and habits of *Physalia*. Intell. Obs., 1869.
29. Vital functions of deep-sea Protozoa. Mon. Micr. Journ., 1869.
30. Undescribed Atlantic Testaceous Rhizopods. Do., 1869.
31. Thalassicollidæ. Ann. Mag. Nat. Hist., 1869.
32. Rhizopods embodying primordial type. Mon. Micr. Journ., 1869.
33. Desmidiaceæ of Greenland. Ann. Mag. Nat. Hist., 1869.
34. The true nature of so-called *Bathybius*. Do., 1875.
35. Deep-sea researches on the biology of *Globigerina*. Pamphlet, 1876.
36. Are desmids and diatoms simple cells? Pop. Sci. Rev., 1877.
37. Development, marking, and reproduction of diatoms. Mon. Micr. Journ., 1877.
38. *Gromia* as a type of foraminiferal structure. Ann. Mag. Nat. Hist., 1877.
39. *Rupertia stabilis*, a new sessile Foraminifer. Do., 1877.
40. Radiolaria as an order of the Protozoa. Pop. Sci. Rev., 1878.
41. The threshold of Evolution. Do., 1880.
42. Contribution to the physical history of chalk flints. Q. J. Geol. Soc., 1880.
43. Origin and formation of flints in the Upper Chalk. Ann. Mag. Nat. Hist., 1881.
44. Supplementary notes on flints. Do., 1881.
45. Siliceous sponge growth. Do., 1881.
46. Discovery of Polycystina in nodular flint cavities. Do., 1883.
47. Patent condenser. Journ. R.M.S., 1884, p. 963, fig. 159.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, Etc.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Development of Sphenodon.—Prof. Arthur Dendy‡ has obtained extensive series of developing eggs of the Tuatara from Stephens Island, and has been able to investigate the development in some detail. The eggs are laid in special holes carefully excavated in the surface soil and subsequently closed with grass and leaves. They seem to take about thirteen months to develop, and are laid in November.

The blastoderm spreads round the yolk very rapidly, and the segmentation cavity is large. The mesoblast arises in part from the primitive streak, in part from cells left between epiblast and hypoblast after the differentiation of the latter. The proamnion originates before the differentiation of hypoblast, so that its first rudiment consists not of epiblast and hypoblast, but of epiblast and undifferentiated lower layer. Owing to the extent to which the head of the embryo sinks down into the yolk, the proamnion is a very conspicuous structure, and persists till a comparatively late stage of development, its presence modifying the shape of certain of the organs. As in Chelonians, there is a distinct posterior amniotic canal. The allantois reaches a great size, its cavity being much greater than that of the amnion. The parietal eye arises from the primary parietal vesicle which originates slightly to the left side of the dorsal surface of the fore-brain. The "stalk" of the parietal eye is probably the right parietal eye retarded in development. In the development of the olfactory organs, a remarkable circumstance is the plugging up of the nostrils with a dense mass of cells. This takes place just before the beginning of the long winter rest, but the suggestion that it has anything to do with the hibernation seems to be negatived by the fact that a similar process was described by Parker in the embryo

* 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, &c., 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 and Reproduction, and allied subjects.

‡ Quart. Journ. Micr. Sci., xlii. (1899) pp. 1–87 (10 pls.).

of *Apteryx*. The notochord seems to arise from the thick sheet of *mesoblast* which grows forward from the primitive streak. In the embryo, just before hatching, each of the four large cutting teeth present in the front of the jaws in the adult is represented by three small teeth, which must fuse together later. No vomerine teeth were observed. The coloration of the embryo is very different from that of the adult, and in the course of the development the following stages seem to be passed through:—(1) longitudinal stripes, (2) transverse bands, and (3) spots. In general the development of the coloration seems to be in harmony with Eimer's conclusions.

Prof. Schauinsland * publishes some brief notes of his observations on this subject. The sub-germinal cavity is very large, and is filled in life with an almost liquid mass which coagulates during preservation. The chorda, mesoblast, and entoblast arise exactly as described by Mitsukuri for Chelonians. The neurenteric canal remains open for a long time. Prof. Schauinsland also noticed the differences between the coloration of the embryo and of the adult described by Prof. Dendy. He promises an illustrated account of the development later.

Development of Ringed Snake.†—Prof. Ludwig Will has investigated the earlier stages of development of *Tropidonotus natrix*, with the view of reconciling the contradictions which exist in the literature of the subject as to the relations of archenteron and neurenteric canal. By Kupffer, a neurenteric canal was described in snake embryos at a very early stage; while Hoffmann, on the other hand, found that it did not appear till late in development. Dr. Will showed several years ago that in the Gecko (*Platydactylus*) the neurenteric canal has an intermittent existence, and he suspected that this might also be the case in snakes. His results justify this surmise. The archenteron in *Tropidonotus* is of small size, and is apparently diminishing, for there is much variation among the embryos in this respect. On account of the small size of the primitive gut, its opening is much less conspicuous than in other reptiles. The opening is formed either by the gradual widening of a single split or by the fusion of several small chink-like openings. The opening so formed puts the archenteron in communication with the segmentation cavity, and, by means of the invagination cavity, with the exterior; it constitutes Kupffer's canal. But this canal does not persist, and is obliterated before the medullary groove closes; later, at the stage when a large number of primitive segments have appeared, it is reformed and constitutes the neurenteric canal. In the reduction of the archenteron, and in certain peculiarities in the formation of endoderm and mesoderm, the author believes that snakes approach birds and mammals more nearly than other reptiles.

Development of the Teeth in Diprotodont Marsupials.‡—Albertina Carlsson has investigated the development of the dentition in two species of *Petaurus*, two species of *Trichosurus*, and *Tarsipes rostratus*. It is necessary to recall the current interpretations.

According to Leche, there are in marsupials three generations of teeth:—(*a*) An anterior prelacteal set which does not cut the gum;

* SB. Akad. Wiss. Berlin, xl. (1898) pp. 629–31. † Tom. cit., pp. 609–18.
‡ Zool. Jahrb. (Abth. Anat.), xii. (1899) pp. 407–24 (1 pl.).

(*b*) the permanent teeth (except the third premolar) and the deciduous third premolar, a set which he regards as homologous with the milk set in other mammals; and (*c*) the third premolar and certain "enamel germs" lingual to the permanent teeth,—a "progressive" set which he regards as homologous with the permanent set in other mammals.

According to Wilson and Hill, however, the persisting teeth of marsupials are homologous with the second set in other mammals; the third deciduous premolar is a true milk-tooth, the prelacteal germs are degenerate milk-teeth, and the "enamel germs" are merely residues of the enamel ridge.

Carlsson comes to the following conclusions:—

(1) The deciduous third premolar belongs to the same generation as the other antemolars, i.e. to the persistent dentition.

(2) Teeth corresponding to the permanent set in other mammals are present in rudiment, but are not developed, with the exception of the third premolar.

(3) Leche's "enamel germs" are what he believed them to be, and seem to be rather progressive than retrogressive.

(4) A prelacteal dentition is represented not only in the front part of the jaw, but also beside the molars. In short, the author corroborates Leche's position.

Development of Teeth in Rodents.*—Herr Paul Adloff has investigated the jaws of the embryos of sixteen different rodents by means of serial sections, in order to determine the homology and succession of the teeth. The result is to show that the large incisors correspond to the second incisors of the typical dentition, a conclusion which was previously arrived at by Cope on palæontological grounds. In the order as a whole two processes have been going on hand-in-hand:—(1) the specialisation of the large incisors, and (2) the reduction of certain other teeth. In the most primitive forms, the Sciuromorphæ, the embryonic dentition is as follows:—

Id_1	—	Id_3	Cd	Pd_1	Pd_2	Pd_3	M_1	M_2	M_3
—	I_2	—	—	—	P_2	P_3			
—	I_2	—	—	—	—	P_3	M_1	M_2	M_3
Id_1	Id_2	—	Cd	—	Pd_2	Pd_3			

As noticed by Leche in other mammals, the lower jaw shows more specialisation than the upper as regards reduction, so that dental germs are present in the upper jaw which are quite absent from the lower. The one exception to this is, that in the lower jaw there are prelacteal rudiments which do not occur in the upper, and also a rudimentary predecessor of the large incisor which is not represented in the upper jaw. Of the prelacteal rudiments, two are especially distinct, one near Pd_2, and another near Pd_3. The latter *fuses with* Pd_3 and helps to form this well-developed tooth. This result leads the author to question Messrs. Wilson and Hill's interpretation of the homologies of the dental germs

* Jenaische Zeitschr. Naturwiss., xxxii. (1898) pp. 347–410 (4 pls. and 4 figs.).

of *Perameles*, and to reassert Leche's doctrine of the existence of prelacteal teeth. Besides these prelacteal teeth, there are traces of a fourth dentition capable of replacing the permanent teeth. As to the origin of the molars, the author supports Kükenthal's view that they are the result of the fusion of the rudiments of the first dentition with the material out of which the second dentition would originate. He believes that the possibility of such fusion is proved by the facts observed by himself as to the fusion of Pd_3 and a prelacteal germ. In the case of the molars, the fusion is believed to be determined by the reduction of the jaw, which prevents the molars of the first dentition from developing until late, so that the hypothetical two sets of molars would develop at the same time did fusion not take place.

Structure and Development of the Lens.*—Prof. Carl Rabl publishes the second of his memoirs on this subject, which deals in a very detailed way with the lens in reptiles and birds. A report must be deferred until the author sums up.

Development of Gymnophiona.†—Prof. A. Brauer continues his account of the development of *Hypogeophis rostratus*, one of the Cæcilians, dealing in this instalment with the gradual assumption of the body-form. The contrast with *Ichthyophis* is interesting.

While *Ichthyophis* has aquatic larvæ, the young of *Hypogeophis* pass from the egg to a mode of life like that of the adults. Thus the development of *Hypogeophis* is relatively condensed, and the visceral apparatus, the segments, the limbs, &c., appear relatively early. The tail-fringe seen in *Ichthyophis* is quite absent; the branchial aperture closes immediately after the degeneration of the gills, while it persists in the free larvæ of *Ichthyophis*; the integumentary sense-organs appear early, and disappear before hatching.

Development of Thymus and Allied Structures.‡—Prof. F. Maurer divides the derivatives of the gill-clefts into two groups:—(1) those which may occur along with an open and functional gill-cleft apparatus (thyroid, post-branchial bodies, and thymus): and (2) those which occur only after the obliteration of branchial respiration, and represent vestiges of a gill-cleft apparatus (epithelial corpuscles and carotid gland). In *Lacerta agilis*, the organs of the first group (with the exception of certain parts of the thymus) occur exactly as in fishes and amphibians. The thymus is restricted to the first three clefts; the first disappears, the second is quite homologous with that in Anamnia, the third extends further ventralwards than in Anamnia, and suggests its position in mammals. There are rudiments of two pairs of epithelial bodies, the anterior pair (in connection with the third cleft) represents the carotid gland in the lizard; the posterior pair (in connection with the fourth cleft) undergoes early degeneration. The author gives some interesting comparative figures.

Formation of the Corpus luteum.§—Herr J. Sobotta has a short paper on Clark's ‖ recent work on this subject. He is of opinion that

* Zeitschr. wiss. Zool., lxv. (1898) pp. 257–367 (6 pls. and 72 figs.).
† Zool. Jahrb. (Abth. Anat.), xii. (1899) pp. 477–508 (4 pls.).
‡ Morph. Jahrb., xxvii. (1899) pp. 119–72 (3 pls. and 4 figs.).
§ Arch. Mikr. Anat., liii. (1899) pp. 546–58.
‖ Arch. Anat. Phys. (Anat. Abth.), 1898.

this author did not exercise sufficient care in obtaining his material, and that his results are therefore unreliable. Clark's statement that the follicular epithelium degenerates immediately after the escape of the egg, is quite inconsistent with Sobotta's observations in the mouse. He objects also to Clark's name of "lutein cells," and believes that the follicles described by Clark were in a state of atresia, and not normal at all.

Eustachian Tube of Frog.*—Dr. H. Spemann points out that the general opinion which homologises the Eustachian tube of Anura with the spiracle of Selachii, cannot be said to be corroborated by embryological investigations, such as those of Goette, Villy, and Gaupp. He has, therefore, re-investigated the subject. He describes in detail the development of the tuba (i.e. Tuba Eustachii + Cavum tympani) from the first visceral cleft, comparable to the spiracle of Selachii. In larval life it grows out into a long forward-directed strand, but the adult condition is phylogenetically more primitive, and the prevalent conclusion as to the homology of the Eustachian tube is thus confirmed.

Origin of Blood-corpuscles in the Lamprey.†—Herr Maurizio Ascoli has investigated this subject, both in the larva and adult of *Petromyzon Planeri*, with the view of determining the vexed question as to the origin of the red corpuscles. He finds that both in larva and in adult the leucocytes increase by mitotic division in the lymphoid tissue of the spiral fold, in the interstitial tissue of the kidney, and in the blood itself. Preparation of blood from larva and adult showed also that the red blood-corpuscles increase in the blood by the same process. The young erythrocytes could, however, at all stages be distinguished from leucocytes, and there was no evidence to justify the hypothesis of Giglio-Tos that they arise from a special kind of leucocyte. The division of the erythrocytes in the blood itself is no doubt the primitive condition for vertebrates, and ceases to occur when special blood-making organs appear.

egeneration and Ontogeny.‡—Prof. H. Strasser made this the subject of a rectorial address. He compares the processes of growth in the two cases, and especially emphasises the importance of the environmental conditions as determining factors. He seeks to arbitrate between the opposed views of Weismann and Hertwig.

b. Histology.

Chromoplasts and Chromioles.§—Prof. Gustav Eisen proposes some new terms for nuclear structures found during his study of spermatogenesis in *Batrachoseps attenuatus*. In the nucleus of the spermatogonium he finds minute chromatin granules for which he proposes the name of *chromiole*. These are strung on threads of linin, and are round and of uniform size. The nucleus also contains two other structures both described as nucleoli. The one of these is the true nucleolus, and stains like the linin granules; for it the name *lininoplast* is sug-

* Zool. Jahrb., xi. (1898) pp. 389–416 (3 pls. and 2 figs.).
† Arch. Mikr. Anat., liii. (1899) pp. 623–31 (1 pl.).
‡ 'Regeneration und Entwicklung,' Jena, 1899, 8vo, 31 pp.
§ Biol. Centralbl., xix. (1899) pp. 129–35 (5 figs.).

gested. The other stains like the chromioles, and is given the name of the *chromoplast.* The chromoplast presides over the formation of the chromosomes, while the lininoplast is a storage reservoir of linin granules.

Structure of Protoplasm.*—Prof. O. Bütschli has found in Nägeli's 'Theorie der Gärung' (1879), pp. 152–6, a theory as to the structure of protoplasm, which in all essentials is identical with Bütschli's own "foam theory." Nägeli expressly stated that in certain cases the foam-like or reticulated structure is quite distinct, and that a gradual transition may be observed between this and an apparently homogeneous structure. He also added the statement that such a foam structure is probably always present, though it may not always be distinctly visible.

Protoplasm of Epithelial Cells.†—H. Bolsius has a note on a communication read by Prof. Heidenhain before the Physik-med. Gesellschaft Würzburg, in January of the present year. Prof. Heidenhain described a peculiar fibrillar appearance in the epithelial cells of the intestine of the frog, and Bolsius points out that cells of similar structure were previously ‡ described by him in the unpaired gland of *Hæmenteria officinalis.*

Structure of Protoplasm.§—Dr. Karl Herxheimer has investigated the cells of the epidermis in man, with special reference to the general question of the structure of protoplasm, and the characters of the fibrils previously described in human epidermal cells. The research was limited to cells removed from living subjects, especially to extirpated condylomata. In such material, when freshly excised and sectioned in a freezing microtome, the cells displayed no fibrils, but merely a distinct protoplasmic reticulum. This reticular appearance is however an optical effect, indicative of the existence of a foam structure. The protoplasmic fibrils show the same staining reactions as the meshes of this network, and the author is of opinion that the appearance sometimes of fibrils, sometimes of a network, is due not to structural differences, but to differences in the methods of staining and fixing, and that in normal human epidermal cells the protoplasm has a honeycomb structure, whatever may be the appearance presented by it. The "protoplasmic fibrils" are probably formed of the material which constitutes the walls of the chambers of the honeycomb.

Structure of Nerve-cells.‖—Herr Vladislav Ruzicka has investigated the so-called Nissl's corpuscles of nerve-cells. He finds that they are not represented in living cells, but are artificial products dependent on the methods of staining employed (staining with toluidin-blue followed by decoloration in water and alcohol). He finds further that the motor cells of the anterior horn on the spinal cord in the ox and in the dog do not all possess longitudinally striated protoplasm, so that this structure cannot be characteristic of motor cells. As to the relations of the constituent cells of the spinal cord, he finds that they may be united to one another by anastomoses, and that they also send out extremely

* Zool. Anzeig., xxii. (1899) pp. 145–6. † Tom. cit., pp. 142–5 (2 figs.).
‡ La Cellule, xii. (1896).
§ Arch. Mikr. Anat., liii. (1899) pp. 510–46 (1 pl.).
‖ Tom. cit., pp. 485–510 (1 pl.).

fine branches, which pass into the fibrils of the surrounding neuroglia. As to the function both of the dendrites and of the fine outgrowths of the nerve-cells, he believes that these constitute the nutritive apparatus of the cells.

Teeth of Reptiles.*—Dr. Hugo Levy has investigated the structure and development of the teeth in reptiles, especially in several species of *Lacerta.* He finds that the teeth consist largely of dentine, but are furnished with a thin cap of enamel. The enamel is essentially similar to that of mammalian teeth, but the prisms are represented only by fine lines in the homogeneous ground-substance. The dentine, as in other animals, consists of a matrix traversed by numerous canaliculi, whose arrangement differs in different reptiles. As to the development of the teeth, the first indication of their appearance is found in the insinking of the innermost layer of the mucous membrane to form the dental ridge. While this is in progress, the connective tissue proliferates rapidly in certain areas which mark the germs of the future teeth, and in these areas becomes almost surrounded by ectoderm. In this process the author believes that the connective tissue papillæ play an active part, and are not merely passively surrounded by the ectoderm cells. Contrary to the conditions which prevail in mammals, these tooth-germs become largely differentiated before separation from the dental ridge. The successional teeth arise either from offshoots of the primitive dental ridge, or from certain nests of epithelial cells produced by the breaking up of the primitive dental ridge. These nests of epithelial cells seem to owe their origin to the connective tissue which interpenetrates the dental ridge, and thus divides it up into separate portions. The enamel of these, as of other teeth, the author believes to be a cuticular product of the epidermal cells, impregnated with lime, after a fashion which is quite analogous to that seen in the cuticle of the Crustacea. The enamel membrane he also regards as merely a cuticular product. Similarly he considers the dentine to be a secretory product of the odontoblasts.

Teeth of Gadidæ.†—Mr. C. S. Tomes has made a study of the differences in the minute structure of the teeth in this family. That there should be great diversity in the dentitions is intelligible enough when we consider how much the members of the family differ in respect of food, habits, size, and external form; "but it is not so easy to understand how the group of influences known as natural selection should have operated in the direction of producing differences of minute structure; for it would seem as though it mattered little what the histological structure of a tooth might be, as far as the exercise of its functions goes, so long as it is sufficiently strong, sufficiently sharp, and of an appropriate shape." The author's general conclusion is against any mechanical theory (kinetogenesis) of the evolution of tooth forms. "For if the form of a tooth is the direct consequence of the direction of stimulation that it has received by use in successive generations, then a tooth which is subject to the very minimum of use, such as that of the gill-rakers of the hake, ought not to be so exact a copy of the teeth round the margins

* Jenaische Zeitschr. Naturwiss., xxxii. (1898) pp. 313–46 (1 pl.).
† Quart. Journ. Micr. Sci., xli. (1899) pp. 459–69 (1 pl.).

of the mouth; and if very considerable use be essential to the maintenance of elaborate structure, then we might expect, on the one hand, that the teeth in the gill-rakers of the hake should be of very simple structure, which is not the case, and, on the other hand, that the large teeth of *Uraleptus*, which must be held to be important in function, and so to receive the stimulus of use, should not have lost the structure typical for the family."

True dentinal tubes are not met with in the Gadidæ. The spear-point enamel is always present, even upon the smallest teeth. The vascular canal system is found in its highest development in those members of the family which have the largest teeth, either fixed to the jaws by anchylosis (ling, some of the teeth of the hake) or by a highly elaborated hinge (the hinge-teeth of the hake). Those which have the teeth small in relation to the size of the animal, as happens in a large number of Gadidæ, and those in which the teeth are not very firmly attached, show also a simplification of the minute structure of the teeth. But mere smallness of size does not necessarily involve simplification of structure, nor large size elaboration. On the other hand, large and small teeth in the same creature present identical structure; and whilst the differences in tooth-structure in some instances follow the lines of the accepted classification of the genera, in others they do not.

c. General.

Problems of Marine Metabolism.*—Prof. K. Brandt, in his rectorial address, directs particular attention to two results of plankton-studies. The first, that the plankton is more abundant in shallow than in deep seas, he interprets on the supposition that in the latter the quantitative distribution of the essential chemical elements falls below the minimum owing to the enormous area involved. The second, that the plankton is more abundant in arctic than in tropical or sub-tropical seas, he interprets on the supposition that the low temperature hinders the action of the de-nitrifying bacteria, which so to speak waste the nitrogenous supplies in the warmer waters, where they flourish more abundantly. The address is a very interesting one, and exceedingly appropriate to the occasion, since the University of Kiel is famous as a centre of plankton-work.

Natural Selection and Mimicry.†—Prof. E. B. Poulton has very carefully discussed the thesis that natural selection is the source of mimetic resemblance and common warning colours. The resemblances of mimicry and common warning colours have certain salient features in common, certain peculiarities which are apt to manifest themselves repeatedly; they also bear certain general relationships to other resemblances in organic nature. In this paper Prof. Poulton has attempted to set down all the general statements which can be made as to the phenomena under discussion. These general statements represent an enormous number of observed facts; and on any theory which is not based upon selection, the whole of the facts upon which the generalisations rest become mere coincidences, and receive no explanation of any kind.

* 'Ueber den Stoffwechsel im Meere,' Kiel, 1899, 8vo, 36 pp.
† Journ. Linn. Soc. (Zool.), xxvi. (1898) pp. 558–612 (5 pls.).

Under the theory of natural selection, however, the vast body of facts becomes at once intelligible. "Here the accumulated facts of the most diverse kind, which receive an intelligible explanation by the theory in question, yield a firm support to the theory. There are many theories which are held upon indirect evidence of precisely the same nature. We believe in evolution, not because we see it taking place, but because of the immense number of observed facts which it renders intelligible." At the same time a considerable amount of direct evidence of the action of natural selection in relation to mimicry and common warning colours is already forthcoming.

Function of Pyloric Cæca in Teleostei.*—Th. Boudouy finds that these tubes have considerable digestive importance. In *Merlangus pollachius* and *Motella mustela* the secretion digested fibrin and hydrated starch; in *Mugil chelo* (herbivorous) there was no digestion of fibrin, but a saccharifying of starch.

Laws of Morphology.†—Prof. Paul Jaccard discusses organic form and its causation. He distinguishes two main factors in evolution:—first, the action of the environment, which is said to produce adaptive variation varying according to the stage of evolution in which the organism occurs, but not to be the cause of evolution; second, physiological division of labour, which is the prime cause of evolution, and is the result of the properties of living matter. To this the adaptive variations are subordinate. This thesis is illustrated in detail.

Resemblance between Arctic and Antarctic Marine Faunas.‡—Prof. D'Arcy W. Thompson has subjected the "bipolar hypothesis" to searching criticism, and decides emphatically against it. He finds that the evidence of the specific identity of northern and southern forms is very weak; it will not hold for Tunicates, Holothurians, Crustaceans, or fishes. "We have found no single species of fish, of Decapod, of Isopod, no certain one out of a large fauna of Amphipods, to inhabit at once the Arctic and Antarctic oceans, or the regions adjacent thereto. Moreover, apart from specific identity, it has not been shown that similar and truly allied forms give to the two regions a common facies."

Origin of Cave Faunas.§—Mr. C. H. Eigenmann publishes very brief abstracts of several papers on the fishes of American caves. He has examined numerous members of the Amblyopsidæ, some of which live in the open and others in caves. He finds that those living in the open show marked degeneration of the eyes similar to that which occurs in the cave-dwelling forms, but less marked. Some of the cave-dwelling forms have mere vestiges of eyes, while others found in the same caves have well-developed eyes; all, when kept in an aquarium, show marked avoidance of light. He believes that the degeneration of the eye began before the fish entered the caves, and is phyletic and not primarily due to the cave habitat.

Variation in Fishes.‖—Mr. W. T. Moenkhaus has investigated the variations of the dorsal and anal fins of *Etheostoma caprodes* and *Etheo-*

* Comptes Rendus, cxxviii. (1899) pp. 745–6.
† Bull. Soc. Vaud., xxxiv. (1898) pp. 402–27 (5 pls. and 8 figs.).
‡ Proc. Roy. Soc. Edin., xxii. (1898) pp. 311–49.
§ Proc. Indiana Acad. Sci., 1897, pp. 229–31. ‖ Tom. cit., pp. 207–28.

stoma nigrum in specimens occurring in two lakes in Indiana. He finds that the specimens of both species found in one lake differ from those found in the other lake, that the variations are determinate for each lake, and that the successive broods vary with the varying conditions of the year in which they are born. In *Etheostoma caprodes* the males are more variable than the females; in *E. nigrum* the females are more variable than the males. There is a correlation between the variations of the two fins; thus, when the dorsal spines increase in number, the dorsal rays decrease; when the anal rays increase, the dorsal spines and rays and the sum of the elements in the two dorsals increase.

Variation *versus* Heredity.*—Mr. H. S. Williams, without having sufficiently thought out the terms which he uses, argues in support of the proposition that "variation, and not heredity, is the fundamental characteristic of the phenomena of organisms." But heredity is only a term for the relation between successive generations.

Mr. Williams also maintains, in support of his thesis, that the actual result of selection is the retarding and checking of variation; that variation is but a phase of the fundamental genetic process peculiar to living organisms; that every act of variation is anterior to experience, and thus is necessarily original and genetic, whereas every hereditary act is necessarily secondary to, and the result of experience; and so on.

INVERTEBRATA.

Mollusca.

Fresh-water Molluscs of Celebes.†—Herren P. and F. Sarasin give an account of these, and one of their most striking results is to show that the central lakes contain an ancient and isolated fauna. Thus the Posso lake, which harbours two genera peculiar to itself—*Miratesta* and *Tylomelania*—has not a single form in common with the Matanna and Towuti lakes connected with it by a river.

γ. Gastropoda.

Nervous System of Gasteropods.‡—Professor Henri de Lacaze-Duthiers has an important paper on the ganglia called pallial and stomato-gastric in certain Gasteropods. Additional researches on the subject have deepened his conviction that it is better to consider the central nervous system as a whole, rather than to attempt to ascribe special functions to its parts. Further, he is of opinion that when any organ in a Gasteropod becomes much specialised, it is chiefly the peripheral part of the corresponding portion of the nervous system which becomes modified, while the true centre for the organ alters little or not at all. The development of accessory ganglia on the peripheral nerves often, however, greatly obscures the homologies. As to the nomenclature of that part of the central nervous system which lies beneath the gullet, he prefers to call the whole mass of ganglia the unsym-

* Amer. Nat., xxxii. (1898) pp. 821–32.

† 'Die Süsswasser-Mollusken von Celebes,' Wiesbaden, 4to, 1898, 104 pp. and 13 pls. See Zool. Centralbl., vi. (1899) pp. 200–3.

‡ Arch. Zool. Expér., vi. (1898) pp. 331–428 (4 pls. and 10 figs.).

metrical nerve-centre (centre asymétrique), and to name its constituents from their position (right lateral, left lateral, &c.). This is justified first by the fact that the want of symmetry in this centre is eminently characteristic of Gasteropods, and second, by the fact that there is not constancy in the regions innervated by the individual ganglia. Thus the ganglia called pallial do not always send nerves to the pallium. These statements are proved by a series of dissections and drawings of the nervous system in different Gasteropods.

Anatomy of Acmæa fragilis.*—Mr. M. A. Willcox has made a detailed study of this New Zealand mollusc. The following are the most generally interesting of his observations. The visual organs are pigment-lined pits, apparently capable of contraction and expansion. It is probable that the pigment-cells, as in the Cephalopoda, are capable of some movement, but to a much lesser extent. The heart has only one auricle, the primitively left being only occasionally represented by a rudiment. The ventricle is not divided into two chambers as in *Patella*. The gill consists of two series of transverse lamellæ, and the mantle also acts as a respiratory organ. There is no true cœlom, but a large blood-carrying space represents the "primary body-cavity." One nephridium only is present, and the animals are bisexual, but owing to the marked protandry the hermaphrodite state is of very brief duration. The paper is furnished with a very complete bibliography.

Cellulose-dissolving Ferment in Snail.†—Herren W. Biedermann and P. Moritz have shown experimentally that the cell-walls of many parts of plants—grain of wheat, potato tuber, date endosperm, &c., &c.—are dissolved much more quickly than the starch-grains by the secretion of the digestive gland of *Helix pomatia*. The cellulose-dissolving ferment was not isolated, but its existence seems securely established.

Development of Tethys fimbriata.‡—Dr. Camille Viguier has at various times succeeded in obtaining developing eggs of this Opisthobranch, and publishes some observations on the development. The spawn takes the form of a flattened helix, and the eggs are enveloped in a large amount of glairy substance which is later in large part absorbed by the larvæ. The eggs are quite opaque, being filled with rose-coloured yolk-spherules. They segment completely, two perfectly equal blastomeres being formed in each egg. These blastomeres do not, however, segment simultaneously; one always lags behind the other, so that one side of the egg may consist of macromeres and micromeres, while the other shows still the undivided blastomere. This was also observed by Heymons in *Umbrella*. The author believes it to be the primitive method, and the one which furnishes the best explanation of the ordinary position of the four blastomeres of the second generation. The origin and fate of the macromeres and micromeres are considered in detail, and the results compared with those of Heymons in the case of *Umbrella*.

* Jenaische Zeitschr. Naturwiss., xxxii. (1898) pp. 411–56 (3 pls.).
† Arch. ges. Physiol., lxxiii. (1898) pp. 219–87 (2 pls.). See Bot. Ztg., lvii. (1899) (2te Abth.) pp. 18–9.
‡ Arch. Zool. Expér., vi. (1898) pp. 37–62 (3 pls.).

Arthropoda.

α. Insecta.

Parabiosis among Ants.*—Dr. Auguste Forel applies this term to a new form of association which he discovered in Colombia between a species of *Dolichoderus* and one of *Cremastogaster*. The two lived in one nest, which in the first observed case was a large conquered termites' nest, but the life of the two species was perfectly distinct. The foraging parties of the two species set off from the nest in company, and were often seen running side by side over trees and the ground. Ultimately they separated, to seek each their special food. The galleries of the nest were exactly as left by the termites, and were each occupied by one of the species only without any intermixture of the other; but the galleries of the two species were in free communication. Such a condition of affairs has not hitherto been described for ants. The paper concludes with a list of the kinds of associations found among ants, with examples and definitions.

Embryonic Membranes of Insects.†—Dr. Arthur Willey puts forward a theory as to the phylogenetic origin of trophoblast and serosa, based especially upon his observations on *Peripatus novæ-britanniæ*. In this species the embryos possess a trophoblast which, by virtue of its close proximity to the uterine mucosa, acts as a mucous membrane. The author believes that the oviparous habit of insects is secondary, and that the embryos were once enveloped in a trophoblast, which, like that of *Peripatus novæ-britanniæ*, was an absorbent mucous membrane. When oviparity was acquired, the trophoblast became converted into blastoderm and serosa by substitution. The amniotic cavity, on the other hand, was originally a product of invagination, the invagination being "primitively derived from and associated with a ventral flexure of the embryo."

Japanese Collembola.‡—Mr. J. W. Folsom publishes a second paper on this subject, in which he describes six new species and one new variety. The paper also includes a list of the species at present known to inhabit Japan.

Absorption in the Cockroach.§—Prof. L. Cuénot publishes an interesting criticism of Metalnikoff's results as to the precise area in which absorption takes place in the intestine of *Blatta orientalis*. Prof. Cuénot's earlier researches ‖ led him to the conclusion, also arrived at by others, that the mid-gut is the absorptive area; but Metalnikoff,¶ in re-investigating the matter, came to the conclusion that absorption takes place only in the terminal part of the intestine. His method was to feed the cockroaches on bread soaked in a salt of iron (ferrum oxydatum saccharatum), and later treat the intestine with potassium ferrocyanate and dilute hydrochloric acid. He found that the Prussian blue reaction developed only in the hind-gut, and hence concluded that here only had

* Bull. Soc. Vaud., xxxiv. (1898) pp. 380–4.
† Quart. Journ. Micr. Sci., xli. (1899) pp. 589–609 (6 figs.).
‡ Proc. Amer. Acad. Sci., xxxiv. (1899) pp. 261–274 (3 pls.).
§ Arch. Zool. Exp., vi. (1898) pp. 65–9 (2 figs.).
‖ Arch. Biol., xiv. (1895) p. 293.
¶ Bull. Acad. Sci. St. Petersbourg, iv. (1896) p. 495.

the iron been absorbed. Cuénot, in repeating the experiments, first fed cockroaches for six weeks on food devoid of iron, and still found that the Prussian blue reaction developed in the intestine after treatment with ferrocyanate and acid. Metalnikoff noticed a similar fact, but stated that the intensity of the colour was much less than when the insects were previously fed with iron salts; Cuénot was unable to notice any difference in the two cases. Cuénot next fed the cockroaches with flour mixed with lactate of iron, and succeeded in obtaining a clear blue reaction in the *mid-gut*. He believes that in Metalnikoff's experiments the cockroaches probably did not really swallow the iron salt. The result is therefore to confirm the earlier conclusions. Cuénot also believes that the hind-gut has some iron-regulating function, such as that somewhat hypothetically attributed to the vertebrate liver.

Digestion in Cockroaches.*—Herr Alexander Petrunkewitsch publishes a preliminary note of his researches on this subject in *Periplaneta orientalis* and *Blatta germanica*. He finds that absorption takes place freely in the crop but not in the gizzard, and only to a slight extent in the mid-gut. It occurs also in the cæca and in the thin-walled region of the intestine. He finds that the whole digestive tract is densely permeated by tracheal tubes, and believes that the peritracheal cells have the power of absorbing food-substances, and so nourishing themselves directly.

Mid-gut of Dragonflies.†—Prof. D. N. Voinov describes the epithelium of the mesenteron in the nymphs of *Æschna*, and refers to the recent discussion of the same subject by Mr. J. G. Needham,‡ with whose results he is in general agreement. The mid-gut is not only the area of secretion, where vesicles of digestive juice are abundantly produced, but it is also the area of absorption, and the two functions proceed at the same time. The "peritrophic sac" is not a special secretory product of the anterior meso-enteric zone, but is formed by the entire mid-gut from the secretory cells. Phagocytosis is wholly confined to the amœbocytes of the blood. Excretion is effected by the Malpighian tubules and by the pericardial cells. The latter pass their products into the blood to be eventually eliminated by the Malpighian tubules.

Condylopalama agilis Sund.§—Dr. H. A. Krauss has a note on this species, which was founded by Prof. Sundevall, for a larval form obtained from the bark of a Brazilian tree. Krauss is of opinion that the larva was that of a species of *Embia* (*Olyntha*), most probably of *E. nobilis*.

Colour-variation in Vanessa io and urticæ.‖ — Dr. Friedr. Urech discusses the nomenclature and characters of the artificially-produced colour varieties of these butterflies. He believes that the varieties show that there is a gradual evolution of colour, orange being replaced by red, brown, umber-brown, and finally black. This evolution takes place both in phylogeny and in ontogeny, and determines the appearance of the special colours of the varieties, external conditions such as variations of temperature having only an indirect effect.

* Zool. Anzeig., xxii. (1899) pp. 137–40 (4 figs.).
† Bull. Soc. Sci. Bucarest, vii. (1898) pp. 49–52, 472–93 (2 pls.).
‡ Zool. Bull., i. No. 2. § Zool. Anzeig., xxii. (1899) pp. 147–8.
‖ Tom. cit., pp. 121–33 (3 figs.).

Spermatogenesis in Pentatoma.*—Dr. T. H. Montgomery, junr., has studied the spermatogenesis up to the formation of the spermatid in an insect belonging to the old genus *Pentatoma* (Hemiptera heteroptera). He describes (1) the spermatogonia and their mitoses; (2) the first spermatocytes from the anaphases to the rest stage; and (3) the spermatocytic mitoses.

The resting spermatogonia are grouped in the form of rosettes, their cell bodies connected at the centre. In the cytoplasm, at some distance from the nucleus, lies a spherical idiozome, within which centrosomes could not be found in the resting cell.

In the prophase of spermatogonic mitosis, the continuous chromatin thread segments into 14 chromosomes, which are at first elongate, and later nearly spherical. In the meantime a pair of centrosomes appears in the idiozome, then leaves the idiozome and wanders towards the nucleus; the centrosomes are connected by a central spindle. The central spindle and pole fibres are of cytoplasmic origin, while the mantle fibres are probably to a great extent derived from the nuclear lining. The idiozome substance appears to take no part in forming the spindle fibres, some of it being still present in mitosis. The chromosomes are grouped in a dense plate in the monaster stage, the mantle fibres being attached to each end of each chromosome.

In the metakinesis the 14 nearly spherical chromosomes are halved, but it could not be determined with certainty whether this is a longitudinal division. Fourteen daughter chromosomes pass into each daughter cell (first spermatocyte), and shortly afterwards the complete separation of these cells takes place. In the metaphase the chromosomes do not fuse together. The connective fibres formed in metakinesis represent each a hollow cylinder of linin formed from the linin of the chromosomes.

The anaphase of the first spermatocytes may be subdivided into three well-marked periods: the early anaphase, the synapsis, and the post synapsis. In the first the 14 chromosomes elongate into threads, one of which becomes the chromatin nucleolus.

In the synapsis the chromosomes are closely grouped near the centre; the chromatin nucleolus shortens and thickens; a true nucleolus first appears closely apposed to the inner surface of the nuclear membrane, so that it is probably cytoplasmic in origin; the idiozome forms a compact mass at one point on the outer surface of the nuclear membrane; in it may be found with great regularity one or two small granules, which are probably centrosomes.

In the post synapsis the chromosomes separate as long nearly smooth threads, usually three or four in number, probably formed by end-to-end coalescence of the 13 chromosomes of the synapsis. The true nucleolus gradually becomes detached from the nuclear membrane; the chromatin nucleolus becomes spherical, and sometimes divides into two or more portions.

The telophase is characterised by the shortening and thickening of the chromosomes, now irregularly monilated. The true nucleolus increases in size and wanders towards the centre of the nucleus: the now spherical chromatin nucleolus is apposed to the nuclear membrane. The

* Zool. Jahrb., xii. (1898) pp. 1–88 (5 pls. and 1 fig.).

idiozome substance commences to disperse over the surface of the nucleus. In this stage and in the post synapsis, large groups of cell syncytia are found, which are characterised by a large quantity of yolk, and by absence of demarcating cell-membranes; these syncytia denote groups of cells which have received an especially abundant nutritive supply; they divide into smaller groups of two or three cells each, before the rest stage, the latter cells developing quite normally.

Of the six follicles in the testes two contain spermatocytes of about double the size of those in the other follicles, the larger size being due to greater increase in the amount of the cytoplasm, idiozome substance, and nuclear sap; in both large and small spermatocytes there are the same processes of reduction division.

The first spermatocytes attain their greatest size in the rest stage: the growth period extends from the synapsis to the rest stage. In the prophase of the first reduction, the chromatin reticulum shortens and condenses into 3–6 long loops; these shorten and thicken, and become dumbbell-shaped. They and the chromatin nucleolus are eventually transversely halved. In the second spermatocytic mitosis the seven chromosomes and the chromatin nucleolus again exhibit a transverse division. As to peculiarities of the spermatogenesis in *Pentatoma*, the following may be emphasised. There are 14 chromosomes in the spermatogonia; in the synapsis of the first spermatocytes one of these becomes differentiated into the chromatin nucleolus; the remaining 13 are reduced to 3–6 during the synapsis; yet in the prophase of the first reduction division, only so many segment transversely as to produce in all cases seven, i.e. exactly half the normal number. The differentiation of a chromosome into the chromatin nucleolus is another peculiarity, and so is the occurrence of large and small spermatocytes.

Montgomery's observations furnish no strict proof of the permanence of the centrosomes. The idiozome apparently takes no part in the formation of spindle-fibres. Since it increases in amount, especially in the growth period of the spermatocytes, and is more voluminous in cells of the large generation, it might represent some metabolic substance connected with processes of nutrition; but if this were the case, since the centrosomes lie within it, the latter might be considered to be agents in the process of nutrition, as well as being the chief mechanical centres in mitosis. In his general considerations, the author gives most attention to the question—what is a chromosome.

δ. Arachnida.

Eyes of Spiders.*—Herr E. Hentschel has studied the structure and development of the eyes in various spiders,—species of *Tarantula*, *Lycosa*, *Attus*, &c. Following Bertkau, he distinguishes the anterior inner pair of eyes from the three other pairs, under the titles *Hauptaugen* and *Nebenaugen* respectively. It must not be supposed, however, that the latter are biologically of less value than the former. The most important conclusions are the following:—

(1) In both types of eyes the nerve-fibres unite with the nucleus-bearing ends of the retina-cells, while the rod-bearing ends are free.

* Zool. Jahrb. (Abth. Anat.), xii. (1899) pp. 509–34 (2 pls.).

(2) In both types of eyes the rods arise at the inner ends of the epidermic cells originally turned away from the light.

(3) In the *Hauptaugen* an inversion of the retina brings the rods in front of the nuclei.

(4) In the *Nebenaugen* the epithelium forming the retina shows only a slight insinking, and the rods lie permanently behind the nuclei of the optic cells.

New Stridulating Spider.*—Mr. R. I. Pocock describes, under the name of *Citharoscelus Kochii* g. et sp. n., a stridulating Theraphosid spider from South America. Hitherto such spiders have only been described from tropical Africa, the Oriental region, and Trinidad. The stridulating organ in the new form is placed between the coxæ of the palp and of the first pair of legs, and is similar to that of the Eumenophorinæ, but less specialised in structure. Mr. Pocock thinks it likely that this spider is identical with that described and figured by Koch as *Mygale rosea* Welck.

ε. Crustacea.

Chelæ of the Lobster.†—Dr. Hermann Stahr has studied in detail the structure of the great claws in 52 specimens of *Homarus vulgaris*, with special reference to the teeth and tubercles of the grasping surfaces. He finds that in the great majority of cases each individual bears chelæ of two different types; the one chela being long, slender, and furnished with regularly alternating teeth of various sizes, and the other broad and heavy, bearing somewhat irregular tubercles. Those of the former type bear also numerous tasting hairs. Not infrequently both claws may be similar and of the toothed type, while rarely forms occur which are transitional between the two types. As the chelæ in *Astacus* approach the toothed type of *Homarus*, while those of Brachyura are tuberculated, the author believes that the former are phylogenetically older. As to the function of the two chelæ in the lobster, the author believes that the toothed claw is a decorative ornament, and is also used in hunting, while the tuberculated claw is used for grasping and crushing.

British Isopod Chelifera.‡—Canon Norman publishes a very useful list of this group, which comprises the two families of Apseudidæ and Tanaidæ. He records twenty-three British species, as contrasted with the seven described by Bate and Westwood. The paper includes an extensive bibliography.

Annulata.

Development of the Capitellidæ.§—Prof. Hugo Eisig supplements his monograph by a detailed and fully illustrated account of the development of the Capitellidæ. The paper is divided into four main divisions: (1) The development of embryo and larva; (2) the development of the organs and germ-layers; (3) discussion of the origin of Annelids; (4) observations on segmentation and the germ-layers. The first part closes with a complete table of the segmentation and of the fate of the various cells, and is throughout too detailed to admit of abstraction. The

* Ann. and Mag. Nat. Hist., iii. (1899) pp. 347–9.
† Jenaische Zeitschr. Naturwiss., xxxii. (1898) pp. 457–82 (2 pls. and 1 fig.).
‡ Ann. and Mag. Nat. Hist., iii. (1899) pp. 317–41.
§ M.T. Zool. Stat. Neapel, xiii. (1898) pp. 1–292 (9 pls. and 4 figs.).

following are among the most interesting of the observations recorded in the second part. The cuticle of *Capitella* has nothing to do with the vitelline membrane, but is a new formation formed at the close of gastrulation when the vitelline membrane is thrown off In the anterior region of the embryo during the early stages the ectoderm contains numerous unicellular glands, which the author believes to be excretory and to functionally replace the absent head-kidneys. They diminish in size after the fifth day. After the throwing-off of the vitelline membrane, the larva is during the greater part of its life uniformly covered with cilia, which later disappear. A somewhat similar condition exists in *Terebella*, but is of much briefer duration. The prototroch in *Capitella* develops very slowly, and is not functional until the fifth day, and as soon as it has reached its full development it begins to degenerate and is partially cast (cf. *Polygordius*). Simultaneously with the prototroch there appears a ciliated area near the mouth, described by Hatschek as the "ventral ciliated band." This the author regards as a part of the typical trochophora, and he gives it the name of *neurotrochoid*. He agrees with Hatschek in regarding it as the remnant of the orthostomodæum of the Ctenophore ancestor. In the formation of the stomodæum there are two independent primordia, one for the stoma and one for the œsophagus-pharynx. This was also noticed by Kleinenberg for *Lopadorhynchus*, and by Zelinka for the Rotatoria. The author explains it by the suggestion that the prostoma originally opened directly into the mid-gut. From this prostoma an ectodermal œsophagus grew out between prostoma and mid-gut. This structure developed into a protrusible pharynx or proboscis, and in consequence of its movements a new opening, the true stoma, developed, which opened to the exterior, and so forced the prostoma inwards. This hypothesis is held to explain the various conditions of prostoma and stoma seen in the development of different animals. It will be noted that according to it the stoma is phylogenetically younger than the œsophagus-pharynx. The author believes that the development of the nervous system does not support the view that the ventral cord arises from lateral nerves, but rather Goette's suggestion that it is derived from an anterior pair of ventral ganglia. The development of the *Nebendarm* seems to support the author's view that this is to be regarded as a *Darmrinne*.

As to the origin of the Annelids, the author believes that the trochophora has a phylogenetic significance, and that it was derived from a Ctenophore-like form. The pole-cells of the mesoblasts (teloblasts) are derived from the sex-cells of the Ctenophore, and therefore arise neither in ectoderm nor in endoderm. The Turbellaria are not on the direct line of Annelid descent, but are derived from a trochophora-stage.

Regeneration in Tubifex.*—Herr H. Haase has studied the regenerative processes in *Tubifex rivulorum* Lam., with especial reference to the food-canal and nervous system. The fore-gut, with the exception of a small anterior portion, is regenerated from the endoderm, whereas its ontogenetic development is ectodermic. The hind-gut is regenerated as it develops, namely from the ectoderm. In regeneration the supra-œsophageal ganglion arises from paired ectodermic proliferations, but these have, to begin with, a ventro-lateral position. The ventral cord,

* Zeitschr. wiss. Zool., lxv. (1898) pp. 211–56 (2 pls. and 11 figs.).

which has a paired origin in ontogeny, is regenerated from an unpaired proliferation of the ectodermic epithelium.

Enigmatical Bodies in Body-cavity of Ophelia.*—MM. Kunstler and Gruvel have investigated in *Ophelia bicornis* the peculiar structures sometimes described as amœbocytes. These structures are especially remarkable in that they contain an internal elongated axis of dark brown or black colour, which divides the protoplasm of the cell into two unequal portions, whose margins usually bear pseudopodial elongations. A nucleus is imbedded in the protoplasm near the axial rod. The corpuscles float freely in the perivisceral fluid, and, according to the authors, are different at every stage of development from the true lymph-corpuscles of the fluid. They vary greatly in number, but are rarely entirely absent. One of their most striking characteristics is the fact that they reproduce themselves rapidly, the axis playing an important part in the process. It gives off small dark-coloured buds, which become free in the general protoplasm. At about the same time the nucleus begins to divide up, and these secondary nuclei become associated each with one or more of the axial buds, and surround themselves with a layer of protoplasm. The completed buds then pass out into the surrounding medium, and grow to the adult size. After rapid production of such buds, the parent elements exhibit senile changes, but seem to possess recuperative power, and by "condensation of their protoplasm become converted into young forms."

The authors believe that these observations confirm the view previously expressed by one of them (M. Kunstler), that these structures are aberrant parasitic Rhizopods (*Dumontia opheliarum*).

In another brief note † the authors reject the suggestion made by M. P. Stéphan, that these structures are analogous to certain abnormal blood-corpuscles found in decomposing specimens of the fish *Merluccius vulgaris*.

Researches on "Palolo."‡—Dr. Augustin Krämer gives some account of his observations on this curious form, which he studied in Melanesia at the same time as did Dr. Friedländer. In some respects he disagrees from the views recently expressed by the latter. § He was early shown the "Palolo stones" by the natives, but disbelieved their statements that the worms came out of such stones, until he noticed the fact for himself by chance. The stones are blocks of coral, partially covered with living polypes, and partially dead coral perforated by worm-tubes. They lie at the edges of little bays usually about 25 metres deep and with a very narrow outlet to the sea, in water shallow enough to leave them uncovered at low spring tides. The stones contain a variety of worms; but Krämer is of opinion that the true Palolo is *Lysidice viridis* Gray, and not a species of *Eunice* as Friedländer suggested. As to the cause of its periodical appearance at the surface, the author emphasises the low spring tides and the position of the sun in the zenith as the determining causes of the swarming, together with the darkness of the nights at the times when the worms appear.

* Arch. Anat. Microsc., ii. (1898) pp. 305–54 (2 pls. and 2 figs.).
† Comptes Rendus, cxxviii. (1899) 2 pp.
‡ Biol. Centralbl., xix. (1899) pp. 15–30 (4 figs.).
§ Cf. this Journal, 1898, p. 426.

Platyhelminthes.

Maturation and Fertilisation in Cerebratulus.*—Mr. W. R. Coe has studied these phenomena in the ova of *Cerebratulus marginatus* Renier, and has found that their general course is closely similar to that in echinoderms, annelids, molluscs, &c. Some of the most noteworthy features may be cited. Only a minute portion of the chromatin network of the germinal vesicle enters into the formation of the sixteen ring-shaped chromosomes found in the first polar spindle; the rest is absorbed by the cytoplasm. The aster-fibres at the poles of the second polar spindle are in part formed *de novo*, and are in part identical with those at the inner pole of the first polar spindle which have been transferred to the new centres. The centrosomes remaining after maturation become lost among the chromosomal vesicles which fuse to form the female pronucleus.

The centrosome of the sperm-aster early divides into two; the daughter-centrosomes move apart with the formation of a beautiful central spindle. The fibres of the original aster become arranged at right angles to this central spindle; those at its ends are collected into two groups about the daughter centrosomes, while those nearer its equator degenerate. The central spindle is torn asunder by the further separation of the centrosomes, and its fibres are apparently transformed into aster-fibres. The two asters thus formed may separate widely or may remain near together. They may slightly precede the sperm-nucleus towards the centre of the egg, or may leave it far behind. In all cases, however, they come to lie near together between or beside the germ-nuclei when these are nearly ready for fusion. The sperm-asters reach their greatest development just before the union of the germ-nuclei; thereafter they begin to degenerate. The cleavage-asters have absolutely no relation with the sperm-asters, unless it be in the possession of the same centrosomes. The centrosomes are always very small, though sharply defined; their centrospheres are at first homogeneous, but increase enormously in size, and acquire a distinct vesicular structure as in echinoderms; about each centrosome an exceedingly delicate aster is formed out of the reticulum of the centrosphere. The plane of cleavage passes through the region where the polar bodies were formed. One of the most remarkable features is the great persistence of the degenerating aster-fibres in the inner aster of the second polar spindle, in the sperm-asters, and in the cleavage-asters.

Central Nervous System of Cestoda.†—Dr. Ludwig Cohn has studied this in eight species of *Tænia*, in *Bothriocephalus rugosus* and *B. hians*, in *Solenophorus megalocephalus*, *Ligula digramma*, and *Schistocephalus dimorphus*. He has come to the conclusion that all the longitudinal strands in the scolex and in the chain of proglottides, along with all the commissures which connect these, constitute the central nervous system, as contrasted with the peripheral branches to the various organs.

The chief commissure is only a bridge between the two main strands; it forms no central organ, but merely a chiasma; the median (dorsal and ventral nerves) do not spring from it, but simply communicate through

* Zool. Jahrb. (Abth. Anat.), xii. (1899) pp. 425–76 (3 pls.).
† Op. cit., xii. (1899) pp. 89–160 (4 pls. and 9 figs.).

it with the fibres of the main strands. Nor is there any histological evidence that the commissure represents a central organ.

Phylogenetically, the primitive condition was probably the irregular diffuse network from which the two main longitudinal strands were first differentiated.

Parasites from Berbera.*—Dr. Max Lühe describes various Helminths found during an African expedition. In 11 specimens of the flamingo found near Tunis, two adults of *Amabilia lamelligera* Owen were found, and also three other smaller *Tæniæ*. The first of these was *Tænia liguloides* Gerv., not previously described for the flamingo. With it occurred numerous small worms which were identical with *Tænia Caroli* Par.; but, as examination showed these to be merely immature examples of the preceding form, the species *T. Caroli* Par. must therefore be dropped in favour of Gervais' species. The remaining examples constitute new species described as *T. megalorchis* sp. n. and *T. ischnorhyncha* sp. n. Among other parasites were a new *Distoma* (*D. micropharyngeum* sp. n.) in the gall-bladder, and an *Echinostomum* (*E. phœnicopteri*) in the small intestine.

In civet-cats from the neighbourhood of Tunis the author also found some new species of *Dipylidium*. To one of these he gives the name of *D. triseriale* sp. n., to the other—a nearly related form—that of *D. monoophorum* sp. n.

Trematodes in Freshwater Mussels.†—Mr. C. A. Kofoid notes that *Aspidogaster conchicola*, which infests the pericardium, liver, and kidneys of many Unionidæ, occurs in America as well as in Europe; that *Cotylaspis insignis* Leidy is a sexually mature form, and not a stage in the life-cycle of *A. conchicola* or of any other species; that *Platyaspis anodontæ* Osborn is a synonym of *Cotylaspis insignis*; and that Monticelli's genus *Platyaspis* cannot be reduced to a synonym of *Cotylaspis* from data at present available.

Variation in Distoma.‡—Herr Severin Jacoby has recently obtained eleven specimens of *Distoma heterolecithoides* Braun, a species remarkable for its unpaired yolk-gland. In eight of the specimens the yolk-gland was at the left side, in three at the right. Close examination showed that other variations of the reproductive organs are also common. In the nearly related *D. lanceolatum* Rud., similar variations occur, thus five examples out of sixteen showed complete inversion of the genitalia.

Appendiculate Distomes.§—Dr. H. S. Pratt describes in detail an appendiculate Distome—probably identical with *Apoblema appendiculatum*—which seems to have its first host in a Copepod (e.g. *Pseudocalanus*). and its second in a fish (e.g. *Clupea*). He discusses the integument and cuticula, the musculature and parenchyma, the alimentary, nervous, excretory, and reproductive systems. He interprets the appendix, provisionally, as the excretory vesicle, or at least the hinder portion of it, which has evaginated in order to increase the length of the body, perhaps

* SB. Akad. Wiss. Berlin, xl. (1898) pp. 619–28 (4 figs.).
† Zool. Bull., ii. (1899) pp. 179–86.
‡ Zool. Anzeig., xxii. (1899) pp 133–5.
§ Zool. Jahrb., xi. (1898) pp. 351–88 (3 pls.).

for the accommodation of a larger uterus. Whether this interpretation is or is not correct an investigation of the development must determine.

Notes on Parasites.*—Dr. Bruno Galli-Valerio has a brief note on *Distoma cylindraceum* Zeder, a common parasite in the lungs and other organs of the body in the frog. The parasite produces a tubercular appearance in the affected organ, and sections through such organs without previous examination are apt to have a very deceptive appearance. Dr. Galli-Valerio believes that the parasite described by M. Gebhardt † as *Coccidium pylori*, and found in tumours in the stomach of the frog, was nothing but the eggs of this *Distoma*. The paper includes also a note on *Uncinaria duodenalis*, the parasite which produced the dangerous anæmia which attacked the workers in the St. Gothard tunnel. There is much reason to believe that the symptoms are produced not wholly by any direct injury to the mucous membrane, but by toxic substances secreted by the parasite, which find their way into the blood and destroy the red corpuscles. The author thinks this suggestion is confirmed by an observation he made upon a cat infested by another species of *Uncinaria*. The animal showed the usual symptoms of anæmia accompanied by epileptic fits, and succumbed rapidly; yet neither at the autopsy nor during the previous observations were a large number of parasites observed. This seems to be opposed to the theory that the injury is mainly direct. The paper includes a historical account of the distribution of the parasite, of the observations made upon it, and of the prophylactic measures suggested at various times. There seems reason to believe that infection can take place through the skin as well as by the mouth.

Structure of Geoplana.‡—Dr. K. Krsmanović gives a detailed account of the structure of a land Planarian from Celebes, for which he suggests the name *Geoplana steenstrupi* sp. n., and a position beside *G. sieboldi* v. Graff. It differs from the latter in the differentiation of the dorsoventral muscles, the glands and the subcutaneous nerve-plexus, in the size of the eyes, and especially in the structure of the copulatory organs.

Incertæ Sedis.

Larva of Discinisca.§—Prof. F. Blochmann has been able to amplify Fritz Müller's description of a Brachiopod larva. In the main Müller described the larva accurately, but he failed to see the hind-gut, mistook the nephridia for otocysts, and did not adequately analyse the musculature. Blochmann has been led to the conclusion that the larva is not that of *Crania*, as Balfour supposed, but of *Discinisca*, and probably of *D. atlantica*. A full description is given, as far as the state of preservation would admit.

Echinoderma.

Reproductive Organs of Holothurians.‖—Dr. L. Bordas has studied those of *Holothuria tubulosa*, *H. poli*, *H. impatiens*, and *Stichopus regalis*. He points out the absence of copulatory organs and of dimorphism in

* Bull. Soc. Vaud., xxxiv. (1898) pp. 371–9. † Virchow's Archiv, cxlvii. (1897).
‡ Zeitschr. wiss. Zool., lxv. (1898) pp. 179–210 (2 pls.).
§ Zool. Jahrb., xi (1898) pp. 417–26 (1 pl.).
‖ Ann. Faculté des Sci. Marseille, ix. (1899) pp. 187–204 (1 pl.).

the gonads. In some species only are there tubular accessory glands, rudimentary in character. The essential structure is that of a series of more or less elongated tubes, simple or branched, debouching into a reservoir enveloped by the dorsal mesentery. From this reservoir an efferent duct leads to a short papilla on the dorsal anterior surface. The genital rudiment or primordium is found in a mass of spherical cells in the dorsal mesentery. *Inter alia*, he comments on the edibility of the genital organs.

Histologically the reproductive organs in the two sexes are closely alike. There is, first, an external ciliated membrane, then follows a muscular layer with longitudinal fibres (sometimes absent) and (thicker, more internal) circular fibres, then a connective and fibrillar membrane, to which is apposed a basilar membrane bearing the germinal epithelium.

Echinoderm Fauna of New Zealand.*—Mr. H. Farquhar gives a list of ninety species, including a large number of peculiar forms, which give the Echinoderm fauna of New Zealand a strongly distinctive character of its own. Its affinities are strongest with that of Australia. Only two Crinoids, dredged by the 'Challenger,' have as yet been found in New Zealand seas, and they both extend beyond the area. Nearly all the Ophiuroids and most of the Asteroids are endemic, while all the Echinoids, except perhaps *Goniocidaris umbraculum*, occur elsewhere, a large number being widely ranging forms. The littoral Holothurians, on the other hand, are all peculiar to New Zealand. Omitting doubtful and deep-water forms, 58 per cent. of the recorded species of New Zealand Echinoderms are endemic; 36 per cent. occur in Australia; and only 6 per cent. have been found elsewhere and not in Australia.

Cœlentera.

Nervous System of Siphonophora.†—Dr. Theodor Schaeppi has investigated the histology of several members of this group, with special reference to the nervous system. The paper does not lend itself readily to the purposes of an abstract, but the following are among the more striking of the contained observations. In the stem of *Forskalia* and the Anthemodinæ the author finds that the structure described by Korotneff and Schneider as the central nervous system is merely a prolongation of the endoderm of the central canal. This central canal sends out short branches which come to lie immediately beneath the ectoderm, so that at these areas endoderm and ectoderm are in contact, the middle lamella being absent. On the dorsal and lateral areas of the stem the ectoderm consists of (1) epithelial muscle-cells; (2) ganglion-cells; (3) the cells of the interstitial layer; while on the ventral surface it consists only of "indifferent" cells and of ganglion-cells. This ventral surface is also furnished with small projections formed by clusters of ectodermal indifferent cells resting directly upon the endoderm without the intervention of a supporting lamella. Other Siphonophora show some variation as compared with this type, but the absence of the middle lamella at certain points is very characteristic of all. Thus the structure described as a nerve-groove in *Apolemia* and *Praya* is not

* Proc. Linn. Soc. N.S. Wales, xxiii. (1898) pp. 300–27.
† Jenaische Zeitschr. Naturwiss., xxxii. (1898) pp. 483–550 (7 pls. and 11 figs.).

nervous at all, but is analogous to the endodermal canals of the Anthemodinæ, and is similarly characterised by the absence of the middle lamella. All such structures the author believes to be of importance in regulating the flow of water through the colony, and preventing excessive rise of pressure.

In the swimming-bells of *Physophora* the outer surface of the velum and sub-umbrella is covered by ganglion-cells and nerves which constitute a nerve-plexus, but there is no ex-umbrellar nerve-ring like that of Medusoids. There is, however, a narrow but distinct sub-umbrellar ring, apart from which there are no nervous elements in the sub-umbrella. The nervous system of each bell seems to be connected with that of the stem by the "spindle-shaped" organ.

In two species of *Forskalia* (*F. Leuckarti* and *F. Edwartsii*), distinct pigment-spots are present in the bells above the opening of the upper radial canal into the ring canal. The pigment-cells are modified glandular cells, and the author believes that the spots are not sense-organs, but patches of excretory substances.

Fiji Acalephs.*—Prof. A. Agassiz and Mr. A. G. Mayer describe the Acalephs found by them in the Fiji Islands. Altogether 38 species were obtained, of which 26 are new to science. With the exception of two Rhizostomæ, all of the genera are represented by species found in the Atlantic Ocean, and the affinity between the Medusæ of the Fiji Islands and those of the West Indies is remarkably close. In six cases they were unable to distinguish any specific differences between the Fijian species and well-known Atlantic forms. It is interesting to notice that while many characteristic types of tropical Atlantic Medusæ are also found in the Pacific, the most eminently characteristic tropical Pacific forms—the Rhizostomæ—have remarkably few analogues in the Atlantic. The westerly set of the great equatorial current would hinder the entrance of Pacific forms into the Atlantic.

Skeleton-formation in the Anthozoa.†—Mr. G. C. Bourne has made an extensive series of observations on various Anthozoa, in order to determine certain disputed points as to the structure and origin of the calcareous skeleton. In her paper on Madreporian Corals, Dr. Maria Ogilvie ‡ stated her belief that the corallum in these corals is formed by certain cells—"calicoblasts" §—which become calcified and form the laminæ of the skeleton. Mr. Bourne's results lead him to the conclusion that the scales described by Miss Ogilvie as calcified calicoblasts are not cells at all, but "crystalline growths formed by the deposition of needles of lime in a colloid matrix." This colloid matrix is secreted by the true calicoblasts, which are quite distinct from the scales. In this matrix the formation of crystals occurs according to the ordinary laws of crystalline growth, "but the general arrangement of the fasciculi of crystals is dominated, in some manner of which we are ignorant, by the living tissues which clothe the corallum." The paper includes detailed descriptions of the skeletons of various corals and other Anthozoa, and is very fully illustrated.

* Bull. Mus. Comp. Zool. Harvard, xxxii. (1899) pp. 157–89 (17 pls.).
† Quart. Journ. Micr. Sci., xli. (1899) pp. 499–547 (4 pls.).
‡ Phil. Trans. R.S.. clxxxvii. (1896) p. 83.
§ The proper spelling is "chalicoblast."—Ed.

Porifera.

New Sponges.*—Under the names of *Spongilla moorei* and *Spongilla tanganyikæ*, Mr. Richard Evans describes two new sponges collected by Mr. J. E. S. Moore in Lake Tanganyika at a depth of 350 fathoms. The second species was represented merely by a fragment preserved in corrosive sublimate, and was therefore probably so like the preceding species in its external characters as not to be distinguished from it at the time of collection. Internally the differences are striking. Both species contained gemmules; hence their inclusion in the family Spongillidæ. Apart from the gemmules, the first species approaches the Chalinidæ very nearly, and the author is inclined to regard the Spongillidæ as an artificial family, which will probably be eliminated with the advance of knowledge.

Protozoa.

Protozoa of Illinois River and adjacent Lakes.†—Mr. A. Hempel has made a list of the Protozoa and Rotifers found in the Illinois River and adjacent lakes at Havana, Ill. In the list of Protozoa ninety-three species are recorded, one of which (*Difflugia fragosa*) is here described for the first time. The most widely distributed form was *Difflugia globulosa*, which appeared at every sub-station, and was present in nearly every month of the year. One peculiar fact noted was the occurrence of a number of Rhizopods in the surface towings; nine species of *Arcella* and *Difflugia* formed a frequent component in the catches.

Galvanotaxis of Amœba.‡—Dr. Schoenichen has a brief note on this subject. Verworn observed that when a constant electric current is passed through the water in which there are forms of *Amœba*, these flow unerringly to the kathode. Comparing the retraction and protrusion of pseudopodia to the contraction and relaxation of muscle, Verworn supposed that the current stimulated the amœboid cell to contraction on the anode side, whereas nerves and muscles are stimulated toward the kathode side. On the other hand, F. Schenk has maintained that the comparison is illegitimate. The pseudopodia are retracted even with the minimum of stimulation; they are protruded on moderate stimulation; this depends largely on conditions of temperature. Experiments show that in warmed water the pseudopodia are protruded *towards* the anode end. In fact, the movements of the *Amœba* cannot be readily brought into line as yet with muscle-contraction. "There are perhaps not more unsuitable objects for the study of contraction than the Protists."

Conjugation in Vorticellids.§—Herr Hs. Wallengren has studied the phenomena of conjugation in various species of *Vorticella*, and on *Epistylis simulans* Plate which lives on *Asellus aquaticus*. It is to the species of *Epistylis* that the author's conclusions especially refer. The microgonidia do not seem to be so degenerate as Plate described them. There is a vestibular cavity with its ciliary apparatus, a well-developed

* Quart Journ. Micr. Sci., xli (1899) pp. 471–88 (2 pls.).
† Bull. Illinois State Lab. Nat. Hist., v. (1898) pp. 301–88.
‡ Zeitschr. angewandt. Mikrosk., iv. (1898) pp. 201–2.
§ Biol. Centralbl., xix. (1899) pp. 153–61 (3 figs.).

peristomal zone, and a lively action of the contractile vacuole. During the process of conjugation, however, the peristome is retracted, the vestibular cavity, its cilia, and the contractile vacuoles disappear. As the endoplasm of the microgonidium begins to be absorbed by the macrogonidium, folds are formed by the shrivelling of the pellicle of the microgonidium, and these are the bristle-like structures described by many observers. The shrivelled remains of the microgonidium are cast off, and include some residue of the plasmic, especially ectoplasmic, material. Only the nuclei and the bulk of the endoplasm pass into the macrogonidium; so that the distinction between total and partial conjugation is one of degree.

Trichomonas intestinalis Leuckart.*—Herr J. Kunstler has made a detailed study of this Infusorian, which is a common parasite in man and the domestic animals. The body is pyriform, but varies in shape owing to the protrusion of pseudopodia. Its anterior end is furnished with a varying number (2–15) of flagella, inserted in a cavity or cupule which, according to the author, is not the mouth. The surface of the body is furnished with an undulating membrane whose movements give rise to the appearance of cilia. This membrane, characteristic of parasitic Infusoria, the author believes to have been originally a pathological structure produced by the unfavourable conditions of parasitism. The protoplasm of the parasite has an alveolar structure. The author describes a mouth apart from the depression in which the flagella are placed, and also a remarkable "hyaline style" of unknown function imbedded in the protoplasm. The nucleus is oval or rounded. Reproduction takes place by longitudinal division, and a process of encystation was also observed.

Myxosporidia.†—Dr. Fr. Doflein describes nine new forms of Myxosporidia, a group of parasites in animal tissues (especially of fishes and arthropods), of which relatively little is known. One of his most interesting results is the evidence of a "multiplicative" mode of reproduction by division or budding, in addition to the "propagative" mode of reproduction by spores. As to their phylogenetic relationships, he agrees with Thélohan that the Myxosporidia must be regarded as derivable from Rhizopods.

* Bull. Scient. France et Belgique, xxxi. (1898) pp. 185–231 (2 pls. and 28 figs.).
† Zool. Jahrb., xi. (1898) pp. 281–350 (7 pls. and 20 figs.).

BOTANY.

A. GENERAL, including the Anatomy and Physiology of the Phanerogamia.

a. Anatomy.

(1) Cell-Structure and Protoplasm.

Kinetic Centres in Plants.*—M. L. Guignard gives further details of his observations on the process of karyokinesis in the formation of the pollen in *Nymphæa*, *Nuphar*, *Limodorum*, and *Magnolia*.† The formation of multipolar spindles appears to be rather frequent in *Nymphæa*, but is not always followed by a definite bipolar figure. In *Magnolia* the mode of formation of the septa in the pollen-mother-cell is intermediate between the ordinary mode in Dicotyledons and that in Monocotyledons, but approaches more nearly to the latter.

As a general rule (in both animals and plants) the attractive sphere encloses a distinct central corpuscle more stainable than the rest; the centrosome of most authors, the "centriole" of Boveri. The sphere, properly so called, which encloses the centrosome, is of no fundamental importance; it varies in size, and may disappear altogether; its transmission from cell to cell may be observed, especially in cells in which the divisions follow one another in rapid succession. The morphological characters of the sphere also vary, according as it possesses radial striæ or not; it is often differentiated into two zones, an inner hyaline and an outer granular zone. It is the "archoplasm" of Boveri, the "kinoplasm" of Strasburger.

The author then reviews the observations of other workers on the centrosome bodies in various families of Cryptogams. It is the formation of multipolar spindles in the first stages of division which constitutes the most cogent argument for the presence of centrosomes in Cormophytes. Centrosomes, attractive or directing spheres, present all possible degrees of morphological differentiation. If, as Strasburger thinks, the kinoplasm may take their place in their absence, it appears certain that the higher plants may possess differentiated kinetic elements having similar functions to those of the lower plants and of animals.

Karyokinesis in Cobæa.‡—Mr. A. A. Lauson has investigated the earliest stages in the formation of the multipolar spindle in the pollen-mother-cells of *Cobæa scandens*. The cytoplasm of the resting pollen-mother-cell presents a clear uniform appearance; but, as division approaches, a zone of granular substance accumulates about the nucleus, which the author terms the *perikaryoplasm*. It was observed in living cells. When the nuclear membrane breaks down, the perikaryoplasm and the linin of the nucleus form a network of kinoplasm fibres. These grow out into several projections, and become the cones of the multipolar spindle. Spindle-fibres are formed by the elongation of the meshes of the network. The cones elongate, become sharp-pointed, and fuse in

* Ann. Sci. Nat. (Bot.), vi. (1898) pp. 177–220 (2 pls.). Cf. this Journal, 1898, p. 205.
† Cf. this Journal, *ante*, p. 48.
‡ Proc. California Acad. Sci., iii. (1898) pp. 169–84 (4 pls.). See Bot. Gazette, xxvii. (1899) p. 77.

two groups, thus forming a bipolar spindle. The mature spindle is characterised by the great length and crossing of the mantle-fibres. Spindle formation in the second division of the pollen-mother-cells is the same as in the first. No centrosomes were observed in any stage of the process.

Chromatic Reduction in the Formation of the Pollen of Naias.*— M. L. Guignard points out that, in the chromatic reduction which takes place in sexual nuclei, the reduction in quantity as well as in number is secured by the rapidity with which the two divisions succeed one another, allowing no time for the nuclei to enter into a state of rest and to increase the amount of chromatin. He has studied the process in the formation of the pollen of *Naias major*, where the normal number of chromosomes in the vegetative nuclei is 12, and 6 in the sexual nuclei, the smallest number known in Phanerogams. The numerical reduction takes place only when the definite pollen-mother-cell commences to divide to form the four pollen-grains. During the first division of this mother-cell, each chromosome undergoes two longitudinal fissions, becoming quadruple. During the second division, the chromosomes already formed are merely uniformly distributed among the four pollen-nuclei; there is no qualitative reduction.

Nuclear Reduction and Function of Chromatin.†—Criticising H. Spencer's theory of the fundamental principles of heredity, Prof. M. Hartog points out that the process of nuclear reduction involves no necessary reduction in the quantity of nuclear matter, but only in the number of the segments into which it is distributed. Hence it cannot have the physiological function ascribed to it as a "preparation for gametogenesis." He suggests that it is the achromatic plasma or linin of the nucleus that is the transmitter of inherited properties, the chromatin having a purely mechanical function in karyokinesis.

(2) Other Cell-Contents (including Secretions).

Inulin.‡—Dr. H. Fischer gives a detailed account of his researches on the occurrence of inulin in plants, its properties, microchemical reactions, &c. These latter present considerable difficulties, owing to the sphærites or sphærocrystals of inulin being seldom free from admixture with other substances.

From its osmotic properties, Fischer regards the size of the molecule of inulin as 300 times that of fructose, and 150 times [158 in text] that of saccharose, giving the formula $333\ C_6H_{10}O_5 = C_{1998}H_{3330}O_{1665}$.

Inulin gives no reaction with iodine, and the mode of swelling by absorption of water is quite different from that of starch or gelatin. The sphærites increase in volume on absorption of water, but do not pass gradually into the soluble condition, nor do they form paste; on the contrary, they dissolve completely like crystals, or break up into granules. Sphærites of inulin also exhibit a difference from those of other substances in their deep radial fissures, which are sometimes seen

* Comptes Rendus, cxxviii. (1899) pp. 202–7.
† Natural Science, xiii. (1898) pp. 115-20.
‡ Beitr. z. Biol. d. Pflanzen (Cohn), viii. (1898) pp. 53–106.

only under double refraction. The author criticises the views of Nägeli, Meyer, and Bütschli, respecting the nature of the swelling.

Inulin is especially characteristic of the Compositæ, occurring in most of the tribes and a large number of the genera of that order. It is found also in the allied orders Campanulaceæ, Lobeliaceæ, Goodeniaceæ, and Stylidiaceæ, and occasionally elsewhere; very rarely in Monocotyledons. Its presence has been recorded in Algæ, but not certainly in Gymnosperms, Pteridophyta, Bryophyta, or Fungi. There is only one instance of its occurrence in an annual plant. Its main function is undoubtedly that of a reserve food-material in the dormant period, especially in the underground organs.

Proteolytic Enzyme of Nepenthes.*—Further experiments by Prof. S. H. Vines lead him to confirm his previous statement of the remarkable stability of the enzyme of the pitcher-plant. It is in all probability derived from a zymogen present in the gland-cells. The enzyme is essentially tryptic in its character—this may be a characteristic feature of all vegetable proteolytic enzymes—and closely resembles that of the germinating seed, but is more rapid and energetic in its action, and more stable in its nature.

Presence of Simple Organic Compounds in the Vegetable Kingdom.†—Herr A. Lieben claims to have determined the presence in plants (grass and the leaves of trees) of formic and acetic acids, and of a higher fatty acid, probably propionic. The neutral products isolated were methylic and ethylic alcohols.

Presence and Function of Silica in Plants.‡—In the case of cereal crops, Herr V. v. Swiecicki states that the upper portion of an internode is always firmer than the lower portion, in consequence of containing a larger amount of silica. The greatest degree of firmness was found in the first and the fifth internodes. The upper part of the fifth internode, in particular, contains a proportion of silica much above the average.

Copper in Plants.§—According to Prof. D. T. MacDougal, copper is an element of very wide distribution in plants, and, in very minute quantities, does not appear to have an injurious effect on them. It occurs in the form of finely divided reddish-brown particles in the tracheids, vessels, and medullary parenchyme.

(3) Structure of Tissues.

Structure of the Wall of Vessels.‖—According to Herr W. Rothert, the ordinary classification of vessels into spiral, annular, reticulated, and those with bordered pits, rests on an erroneous view of their origin. The essential structure of the membrane is the same for all vessels; all kinds of vessels are characterised by the presence of bordered pits. These can be classed under two principal heads, according as they are extensible

* Ann. of Bot., xii. (1898) pp. 545–55. Cf. this Journal, 1898, p. 207.

† Monatsschr., xix. (1898) pp. 333–54. See Journ. Chem. Soc., 1899, Abstr., pt. ii. p. 45.

‡ Die Bedeutung d. Kieselsäure u. s. w., Halle a. S., 1898, 45 pp. See Bot. Centralbl., Beih., viii. (1899) p. 288.

§ Bot. Gazette, xxvii. (1899) pp. 68–9 (1 fig.).

‖ Bull. Internat. Acad. Sci. Cracovie, C.R., 1899, pp. 15–53 (2 pls. and 7 figs. in Polish original).

(unrollable) or not. The first kind (annular and spiral vessels) are characterised by the thin parts of the wall running continuously round the vessel, while the thicker parts are not connected longitudinally; hence the membrane is capable of longitudinal stretching, and the thickened portion may, under certain circumstances, become detached. In the second kind, the thin portions of the membrane are not continuous, while the thickened parts are connected in all directions into a network (reticulate and pitted vessels). The character of the perforations is always the same, whether in spiral, annular, or reticulate tracheids; there is either one large round bordered pit, or there are a number of narrow bordered pits arranged in a scalariform manner.

The unrolling of the thickening-bands does not take place, as has hitherto been stated, by the rupture of the unthickened portions of the membrane, but by the detachment of the thickening-bands from the thin membrane, the latter remaining quite intact. "Reduced vessels" may be formed in two ways:—by the attachment of the thickening-bands by their greatest breadth, in other words, by the replacement of the bordered pits by simple pits; or by the incomplete development of the thickening-bands and their looser arrangement.

The author insists also on a uniformity in the physiological purpose of all kinds of vessel. The thin portions permit the passage of water between the vessels and the surrounding elements; while the thickened portions enable them to resist radial pressure.

Modifications of the Primary Cortex in Dicotyledons.* —It has long been known that in dicotyledonous stems the central cylinder may become sensibly thicker without splitting the cortex. This has generally been explained by assuming that the cells of the cortex multiply by radial septation. M. Eberhardt finds the process to be a more complicated one. Taking the ash as a type—from which other trees differ only in immaterial points—the total diameter of the stem does not increase with that of the central cylinder, the cortex being proportionately reduced in thickness. While septation takes place in the inner layers of the cortex, this is not the case with the outer layers; the lacunæ at first formed in them disappear as the result of the internal pressure; and finally a considerable number of the cells themselves are destroyed. It is probable that a similar process takes place also in herbaceous stems.

Secondary Increase in the Primary Vascular Bundles of Monocotyledons.†—M. C. Queva finds, in a stem of *Dioscorea illustrata*, a kind of cambial zone formed before the completion of the vessel in the middle portion of the stem, which, however, is soon destroyed by the growth of the surrounding elements, not advancing to the formation of secondary xylem and phloem. In the tubers of *Gloriosa superba* he now finds also vascular bundles which have a distinct cambial zone, not present in the earliest primordium, but forming eventually secondary xylem and sieve-tubes.

Placental Fibrovascular Bundles of Primula.‡—It is often stated that in the vascular bundles which run into the placental column of

* Comptes Rendus, cxxviii. (1899) pp. 463–6.
† Ass. Franç. pour l'avanc. d. sciences, 1897. See Bot. Centralbl., Beih., viii. (1899) p. 295.
‡ Comptes Rendus, cxxviii. (1899) pp. 259–61.

Primula, the usual structure of the cauline bundles is reversed, the xylem facing the periphery, the phloem the centre of the column. But, according to M. E. Decrock, this is not invariable in all species of the genus. It is the case in *P. sinensis* and *viscosa*; but in *P. acaulis*, *verticillata*, *stricta*, *elatior*, and *officinalis*, the phloem of each vascular bundle completely surrounds the xylem, the xylem vessels first differentiated occupying the centre. In *P. scotica*, *longiflora*, and *marginata*, the bundles are also concentric.

Structure of the Alstrœmerieæ.*—Dr. A. Colozza has studied the morphology and anatomy of this natural order, especially in regard to the relationship to *Alstrœmeria* of the genus *Bomarea*, which agrees with the typical genus in some points, while differing from it in others. In both genera there is developed a mechanical ring in the aerial stem and in the rhizome below the cortical parenchyme. While in *Alstrœmeria* the vascular bundles display a tendency to arrange themselves in two circles, in the species of *Bomarea* studied by the author the vascular bundles are regularly arranged in three circles.

Structure of Lemna minor.†—Mr. O. W. Caldwell has made a careful study of the life-history of the common duck-weed. The following are among the more important results.

There is no true differentiation of stem and leaf. The secondary root is formed from a group of hypodermal cells. The epiderm persists for a considerable time as the temporary root-sheath. The root-cap adheres while young to the main body of the root, but becomes entirely free later except at the growing point. Flowers are rarely formed; fertile seeds still more rarely. A single archesporial cell occurs in each stamen; this divides later into 2, and then into 4 masses, each constituting the archesporial mass of a loculus. The primary tapetal layer is not cut off at the first division of the archesporial cells, but after these have become separated into 4 regions. The microspores (pollen-grains) germinate within the sporange. The generative cell remains closely applied to the wall of the spore for a time before dividing. In the megasporange (embryo-sac) the primary tapetal cell usually undergoes no further division, while the primary sporogenous cell passes directly into the megaspore. Normal embryo-sac structures are rarely developed.

(4) Structure of Organs.

Replacement of one Organ by another.‡—M. A. Boirivant gives the following general results of experiments on this subject.

The removal of the leaves (or the blades) causes a larger development of chlorophyll, and consequently a deeper colour, in the stem and petiole, and a modification in the structure of their tissues, with an increase in the number of stomates; and, in consequence, an increase in the power of assimilation and of transpiration, of those organs.

When a primary root is removed, the radicle which takes its place partakes more of the character of a primary than of a secondary root. The same is the case with secondary branches which take the place of a primary branch.

* Malpighia, xii. (1898) pp. 165–98 (2 pls.).
† Bot. Gazette, xxvii. (1899) pp. 37–66 (59 figs.).
‡ Ann. Sci. Nat. (Bot.), vi. (1898) pp. 309–400 (5 pls.).

Structure of the Ovule as a Factor in Classification.*—Pursuing his investigations on the variations in the structure of the ovule in Phanerogams, M. P. van Tieghem classifies the orders of Seminatæ in two groups, the CRASSINUCELLATÆ and the TENUINUCELLATÆ, according as the nucellus, on the one hand, remains considerable in bulk, up to the period of the formation of the embryo, or, on the other hand, is reduced to a single layer of cells, or entirely consumed by the endosperm. Each of these groups can be again divided into Unitegminatæ and Bitegminatæ. Of these four subgroups, by far the largest are the Crassinucellatæ Bitegminatæ, and the Tenuinucellatæ Unitegminatæ. The distribution among these four sub-groups of a number of natural orders is discussed in detail, the position of not a few being greatly modified when classified in accordance with the structure of the ovule.

Embryo and Seedling of the Cactaceæ.†—Dr. W. F. Ganong describes in detail the structure and development of the embryo and seedling and the mode of germination, in nearly all the 18 genera of Cactaceæ. A distinctive feature of the germination is the rapid swelling of the hypocotyl, and the consequent immediate assumption of a succulent habit. When germination is completed and the epicotyl is about to appear, we find an immense range of form, from the very uncactus like *Pereskia* to the nearly globular *Mamillaria* almost destitute of cotyledons. In general, the ground-form of the embryo answers to the ground-form of the adult, and alters with the latter by the working back of newly acquired characters. "There is an occasional expansion of surface, with increased cotyledons and relatively diminished hypocotyl, allowed by exposure to more mesophytic habitat."

Dimorphism in Cruciferæ.‡—Prof. R. Tate identifies the Australian *Geococcus pusillus* F. v. Muell., with *Blennodia cardaminoides* Benth. It differs, however, remarkably from the typical form. The flowers are very small and cleistogamous; the plant is stemless, and the siliquæ are very short, rather thick and turgid, and during ripening, bury themselves in the ground.

Interruptions of the Axile Symmetry in Pedicels.§—M. Pitard has studied the variation which takes place in the structure of the pedicels in compound inflorescences (*Heracleum*, *Sambucus*) dependent on their angle of inclination. The symmetry in the arrangement of the vascular bundles and in the outline of the pedicel may be modified by both internal and external causes; the orthotropous floral axis frequently presenting a bilateral structure.

Bud-Variation.‖—Herr L. Beissner enumerates the various kinds of bud-variation which occur especially in woody plants, resulting in the following forms:—pyramidal and columnar forms; pendent and weeping forms; dwarf forms; forms with deeply divided or coloured leaves, &c. He points out the danger of confounding true bud-variations with variations resulting from unfavourable or other peculiar vital conditions; and

* Journ. de Bot. (Morot), xii. (1898) pp. 197–220. Cf. this Journal, 1897, p. 313.
† Ann. of Bot., xii. (1898) pp. 423–74 (1 pl.). Cf. this Journal, 1895, p. 546.
‡ Trans. R.S. South Australia, xxii. (1898) pp. 122–4.
§ P.-V. Séances Soc. Sci. Phys. et Nat. Bordeaux, 1898, pp. 34–43.
‖ S.B. Niederrhein. Ges. Nat. u. Heilk. Bonn, 1898, pp. 30–42.

states that at present we know next to nothing of the conditions which determine bud-variation.

Primordial Leaves of the Cupressineæ.*—M. A. Daguillon now states that the polymorphism in the leaves of Coniferæ, already recorded by him in the Abietineæ, is not confined to that tribe, but occurs also in the larger number of the Cupressineæ (*Cupressus*, *Chamæcyparis*, *Biota*, *Thuja*, *Juniperus*); the primordial leaves differing from those of the mature plant in their phyllotaxis as well as in definite points of structure, especially in the distribution of the stomates and of the secreting canals, the structure of the hypoderm and of the meristele, &c.

Stomates of Cynomorium.† — Sig. R. Pirotta and Dr. B. Longo describe the occurrence of abnormal stomates in *Cynomorium coccineum*. Besides those of ordinary structure, they find, especially on the bracts and perianth-leaves, others which present various abnormalities. In some, two stomates are in close contact with one another; in others, a partial fusion has taken place, so that two stomates have between them only three guard-cells; in others, septation has taken place, in one or both of the guard-cells, at right angles to the fissure, so that each stomate has either three or four guard-cells.

Locality of the Absorption of Nutrient Substances by Roots.‡ — According to Prof. L. Kny, absorption of nutrient substances by roots is not effected only through the root-hairs, but also through the epiderm in a zone of varying length on the apical side of the root-hair region. The plants experimented on were *Zea Mays*, *Pisum sativum*, and *Hydrocharis morsus-ranæ*; the evidence was furnished by the absorption of methyl-violet, and of nitrates, demonstrated in the latter case by the diphenylamin-sulphuric-acid test. The results were, however, by no means uniform, individuals of the same species showing great variation in this respect.

Nitragin and the Nodules of Leguminous Plants.§ — Miss Maria Dawson states that a study of the nodules found upon the roots of leguminous plants has led her to an unhesitating confirmation of the parasitic nature both of the filaments and of the bacteroids. The formation of tubercles is the result of inoculation, either of the seeds or of the soil, with nitragin, which consists of minute straight micrococcus-like organisms, which become connected into bacteroids and straight rods.

Bowenia spectabilis.‖ — Mr. H. H. W. Pearson has studied the anatomy of the seedling of this remarkable and little-known Cycad. The decompound leaf has a remarkable resemblance to that of a *Marattia*. A point of great physiological interest is the development of numerous curiously branched roots from the upper part of the main root, which at once assume an upward vertical direction of growth, and whose cells contain abundance of *Anabæna* filaments. Their branching is of an exogenous type. The young leaf has a circinate vernation.

* Comptes Rendus, cxxviii. (1899) pp. 256–9. Cf. this Journal, 1889, p. 245.
† Atti R. Accad. Lincei, viii. (1899) pp. 98–100 (5 figs.).
‡ Ber. Deutsch. Bot. Ges., xvi. (1898) pp. 216–36.
§ Proc. Roy. Soc., lxiv. (1899) pp. 167–8.
‖ Ann. of Bot., xii. (1898) pp. 475–90 (2 pls.).

β. Physiology.

(1) Reproduction and Embryology.

Embryo-sac of Gamopetalæ.* — Dr. G. Bolicka-Iwanowska has studied the formation and development of the embryo-sac in certain genera belonging to the orders Scrophulariaceæ, Gesneraceæ, Pedalineæ, Plantaginaceæ, and Dipsacaceæ. The following are some of the general conclusions arrived at.

The presence of a haustorium and the thickness of the integuments are in close relationship to one another; but the presence of a haustorium cannot in itself be considered a sound basis for classification. A haustorial apparatus occurs in the Scrophulariaceæ (Antirrhineæ and Rhinantheæ), Utriculariaceæ, Pedalineæ, and Plantaginaceæ, and in *Campanula rotundifolia* and *Lobelia inflata* among Campanulaceæ. The haustorium having always for its purpose the conduction of nutrient substances, it has usually a direct connection with a special nutritive tissue, and the haustorium is then located near the chalaza; when it is situated near the micropyle, there is often no special nutrient tissue. In the genera where there is a chalazian haustorium, there is no true fibrovascular bundle in the integument, though there may be in the placenta.

The author attributes to the nucleus an important nutritive function. The cells of the haustorium are not generally invested with a membrane; and when one is formed it rapidly becomes gelified. The tapetal cells do not appear to play any part in the protection of the embryo-sac; they probably form a ferment and serve a digestive function; for they are often very persistent. The synergids have no permanent nutritive function; they always disappear after impregnation. In the genera studied, the antipodals, when present, have only a temporary function.

Embryo-sac of Compositæ.†—Mlle. M. Goldflus has studied this subject in a number of genera and species, especially in relation to the structure and functions of the epithelial layer and the antipodals. As a general conclusion, she states that the embryo-sac of Compositæ is surrounded by the inner layer of the integument of the ovule differentiated into digestive cells. The antipodals are usually arranged in a row which penetrates, like a haustorium, into the axial portion of the ovule. The antipodals are generally connected with a string of conducting cells pointing towards the extremity of the raphial bundle, and appear to furnish a connecting link between the embryo-sac and the elaborated digestible substances in the ovule. But the number and arrangement of the antipodals differ greatly in the different genera.

The integument is at an early period differentiated into an outer and an inner portion; the latter, surrounding the base and sides of the embryo-sac, has frequently been confounded with the nucellus, and has a distinct nutritive function. As a rule, there is no epithelial layer between this portion of the integument and the ovules. The antipodals and epithelial cells of Compositæ are less erythrophilous than the sexual

* Flora, lxxxvi. (1899) pp. 47–71 (8 pls.).

† Journ. de Bot. (Morot), xii. (1898) pp. 374–84; xiii. (1899) pp. 9–17, 49–59, 87–96 (6 pls. and 18 figs.).

apparatus; but are not so decidedly cyanophilous as the antipodals of Monocotyledons.

With regard to the function of the antipodals, the authoress expresses her general concurrence with the conclusions of Westermaier.*

Cross-pollination and Self-pollination.—Sig. L. Nicotra † has investigated the mode of pollination in a number of orchids belonging to the tribe Ophrydeæ, natives of Italy. Although the larger number are abundantly visited by insects, and show evident adaptations for cross-pollination; in others, including the bee-orchis, the visits of insects are rare, and fertility appears to depend primarily on self-pollination.

The mode of pollination of various species of Cucurbitaceæ has been investigated by Dr. A. Brizi.‡ He finds them, as a rule, pollinated by the agency of Hymenoptera (Apidæ); and the author supports the old view that they are attracted by the conspicuousness of the corolla, the flower affording a large amount of scentless nectar. The structure and position of the nectaries promotes the visits of these pollinating insects, while it hinders those of useless or injurious insects, such as ants.

Dr. E. Ule § finds the structure of the organs in *Aristolochia Clematitis*, as in *A. Sipho*, to point to the absolute necessity of cross-pollination. When the anthers are mature, the surface of the stigma has completely dried up and the stylar canal is closed.

Relation between Insects and Flowers.‖—Continuing his observations on the agencies by which insects are attracted to flowers, Prof. F. Plateau now gives a large number made on *Salvia horminum* and *Hydrangea opuloides*, confirming his previous statement that they are not chiefly attracted by the sense of sight. Neither the coloured bracts in the former nor the conspicuous sterile flowers in the latter plant can be regarded as "vexillary." In both cases the pollinating insects make their way at once to the flowers which contain the honey without being visibly guided by the showy organs in either case; while, if these are removed, it does not appear to make any material difference in the number of insects which visit the inflorescence.

Cleistogamous Flowers of Bromeliaceæ.¶—In 24 species of Bromeliaceæ, natives of Brazil, mostly belonging to the genus *Nidularium*, and many of them now described for the first time, Herr E. Ule finds cleistopetalous flowers. The author believes them to be in almost all cases pollinated by the agency of humming-birds.

(2) Nutrition and Growth (including Germination, and Movements of Fluids).

Action of the Röntgen Rays on Vegetation.**—The results of a further series of experiments have convinced Prof. G. F. Atkinson that the Röntgen rays do not in any way injure the growth or the sensitiveness of plants. The observations were made on a variety of seedlings placed in a Crookes apparatus, on flowers, on bouillon-cultures of

* Cf. this Journal, 1891, p. 766.
† Bull. Soc. Bot. Ital., 1898, pp. 107–15. ‡ Tom. cit., pp. 217–22.
§ Ber. Deutsch. Bot. Ges., xvi. (1898) pp. 236–9. Cf. this Journal, 1898, p. 646.
‖ Mém. Soc. Zool. de France, xi. (1898) pp. 339–75 (4 figs.). Cf. this Journal, 1898, p. 191. ¶ Ber. Deutsch. Bot. Ges., xvi. (1898) pp. 346–62 (1 pl.).
** Science, vii. (1898) pp. 7–13 (1 pl.). Cf. this Journal, 1898. p. 101.

Bacillus subtilis, on an *Oscillatoria*, and on the leaves of the sensitive plant.

Physiology of the Flower.*—From observations made on a very large number of flowers, M. G. Curtel draws the following general conclusions.

The respiratory power of the flower is, in general, higher than that of the leaves; even when the calyx is green it exceeds the power of assimilation; while in the bud assimilation preponderates over respiration. The respiratory power of coloured flowers is higher than that of white in the same species. Transpiration is more energetic from petals than from foliage-leaves, even to the extent of three or four times as much.

All the parts of the flower—peduncle, calyx, and corolla—acquire a more vigorous development when growing in the sun than in the shade, and the tissues are more completely differentiated. In the shade the flowers are slower in appearing, smaller, less numerous, and less brightly coloured; the fruits are fewer, and contain fewer seeds.

Adaptation of Leaves to the Intensity of Light.†—Prof. J. Wiesner proposes the term *photometric* for those leaves which assume in light, and in consequence of illumination, a definite position in order either to obtain as much light as possible, or to screen themselves from too intense light; while leaves which do not possess this property are *aphotometric*. Photometric leaves are either *euphotometric* or *panphotometric*; the former are those which adapt themselves to obtain the maximum of diffused light; the latter those which adapt themselves to both direct and diffused sunlight. The former are characterised by assuming a fixed position at right angles to the direction of the strongest diffused light. The vegetation of forests and plants which grow in deep shade present the commonest and clearest examples of euphotometric leaves. The "light-absorption" (*Lichtgenuss*) of a plant is the relationship of the intensity of the whole of the daylight to the intensity of the light at the spot where the plant grows. Expressing this by L, then the value of L varies between 1 and 1/100. Euphotometric leaves have always a dorsiventral structure. The leaves of all pines are aphotometric; those of grasses take, as a rule, no fixed light-position.

Effects of the Sun and of Shade on Vegetation.‡—Comparing the dried weight and the chemical composition of the ash of plants grown in the shade and fully exposed to the sun, especially in the case of grasses (*Cynosurus cristatus*), M. Berthelot states that the richness of carbon in a plant is greatest when developed in the sun, least in the after-math. Phosphorus and sulphur, on the other hand, are present in the largest quantity in plants growing in the shade. The proportion of nitrogen is nearly the same in both. Plants growing in the shade appear more vigorous, but this is owing to the suppression or retardation of the function of reproduction.

Influence of Light on the Formation of Nitrogenous Substances.§—M. W. Palladin gives the following as a summary of his recent

* Ann. Sci. Nat. (Bot.), vi. (1898) pp. 221–308 (5 pls.).

† Biol. Centralbl., xix. (1899) pp. 1–15. Cf. this Journal, 1896, p. 540.

‡ Comptes Rendus, cxxviii. (1899) pp. 139–45.

§ Tom. cit., pp. 377–9. Rev. Gén. de Bot. (Bonnier), xi. (1899) pp. 81–105. Cf this Journal, 1896, p. 542.

observations on this subject. Leaves assimilate in light three times as much saccharose as in the dark. In the presence of saccharose the synthesis of proteid substances takes place more energetically in the light than in the dark. The regeneration of proteid substances goes on more energetically in the blue half of the spectrum than in the yellow half. The presence of a large reserve of carbohydrates and the action of light are indispensable for the normal formation of living nitrogenous substances in the leaves.

Assimilation of Carbohydrates.*—According to M. Mazé, the higher plants can live, like those which are destitute of chlorophyll, at the expense of organic substances already formed, when protected from the light; but, in the natural condition, this power is feeble compared to that possessed by Fungi and Schizomycetes.

Relation between the Depth of Colour of Leaves and Chlorophyll Assimilation.†—As the results of a series of experiments on a number of different plants, M. E. Griffon finds that the depth of the colour of green plants cannot be relied on as a measure of the intensity of chlorophyll assimilation. Although in most cases leaves of a deep green display a greater energy that those of a lighter tint, yet in other cases leaves of the same tint possess very different powers of assimilation, or those of a lighter tint may even be more energetic. The thickness of the mesophyll and of the palisade-tissue, and other points of structure, are factors in determining the depth of coloration of the leaves.

Assimilation of Nitrates by Plants.‡—From a series of experiments on the absorption, distribution, and assimilation of nitrates, chiefly by cultivated crops, Herr T. Wölfer draws the following general conclusions. Plants grown in the dark store up nitrates more rapidly and more abundantly than those grown in the light. Plants grown either in the dark or in the light, or in an atmosphere containing a larger amount of carbon dioxide than the normal, contain no starch, and only traces of glucose. Nitrates could be detected only in small quantities in the vascular bundles; a larger quantity in the bundle-sheaths; the largest quantity in the cells of the cortex and parenchyme.

Growth of Viburnum lantanoides.§—According to Miss Ida A. Keller, this shrub begins its growth normally with a main axis, ending in a terminal and two lateral buds. A tendency soon becomes evident towards retarding the growth of the main axis, while the chief energy is transferred to the lateral branches. There is a further tendency to the complete suppression of one of the lateral buds. The true axis is hence often replaced by a false axis, and the species has a decided tendency towards the sympodial method of branching.

Transpiration.‖—Mr. H. H. Dixon regards transpiration as a vital rather than as a physical phenomenon, i.e. as a process which can take place only during the life of the organism. The elevation of the water of the transpiration current, when the leaves are surrounded by a satu-

* Comptes Rendus, cxxviii. (1899) pp. 185–7. † Tom. cit., pp. 253–6.
‡ Beitr. z. Kenntniss d. Aufgabe u.s.w. d. Nitrate in landwirthsch. Culturpflanzen, Rostock, 1898, 61 pp. and 7 pls. See Bot. Centralbl., Beih., viii. (1899) p. 278. § Proc. Acad. Nat. Sci. Philadelphia, 1898, pp. 482–4 (1 pl.).
‖ Proc. R. Irish Acad., iii. (1898) pp. 618–35 (3 figs.).

rated atmosphere, is effected by pumping-actions proceeding in the living cells of the leaves. These pumping-actions are capable of raising the water against an external hydrostatic pressure. In common with other vital actions, they are accelerated by a moderately high temperature, and are dependent on the supply of oxygen. The cells adjoining the terminal portions of the water-conduits appear to possess this activity, and in plants provided with water-glands the pumping-actions are not limited to the secreting tissues of these glands.

(4) Chemical Changes (including Respiration and Fermentation).

Formation of Sugar in the Turnip.*—Herr M. Gonnermann has determined that the formation of sugar in the leaves of the turnip can take place only through the action of an enzyme. There are two enzymes present in the leaves, an invertase and a diastase, and these are distinct from the corresponding enzymes of barley. By their action starch is transformed by hydrolysis into products which are again changed into saccharose, partly in the leaves, but more completely in the parenchyme of the root.

Decomposition of Glucosides by Fungi.†—Herr K. Puriewitsch finds that the mycele of mould-fungi (*Aspergillus niger*, *A. glaucus*, *Penicillium glaucum*) has the power of decomposing glucosides in just the same way as emulsin; and the spores also have the same property when germinating. The resulting substances are glucose and benzol derivatives; the former being taken up by the mycele; the latter either also taken up, or retained in the solution.

γ. General.

Biological Species and Races.‡—Herr E. Rostrup distinguishes between the use of these two terms (in Fungi). In the latter, the capacity for one form to pass over into another has been only partially, while in the former it has been entirely lost. Biological races occur in *Lophodermium Pinastri*; biological species in the genera *Coleosporium* and *Melampsora*. In *Puccinia graminis* are a number of biological races, each of which is limited to a definite host-plant; while biological species also occur in the same genus. *P. coronata*, with æcidia on *Rhamnus Frangula*, and basidial fructification on *Agrostis* and *Calamagrostis*; also *P. coronifera*, with æcidia on *R. catharticus*, and basidial fructification on *Avena* and *Lolium*, are biological species.

Alternation of Generations.—Prof. G. Klebs § discusses the question of alternation of generations in the Thallophytes, recapitulating the views of different authorities. He concludes that the majority of Algæ and Fungi have two or more kinds of propagation; but there is no reason, in these cases, for speaking of an alternation of generations. Such an alternation does, however, occur in the heterœcious Uredineæ, and in certain Diatoms, if the present theory of the cause of

* Zeitschr. Ver. Deutsch. Zuckerind., 1898, p. 667. See Bot. Centralbl., Beih., viii. (1899) p. 280.

† Ber. Deutsch. Bot. Ges.. xvi. (1898) pp. 368–77.

‡ Bot. Tidskr., xx. pp. 116–25. See Bot. Centralbl., Beih., viii. (1899) p. 298.

§ Ann. of Bot., xii. (1898) pp. 570–83.

the formation of auxospores is correct. Neither in the Florideæ nor in the Ascomycetes is there any true alternation of generations.

In reference to the alternation of generations in the Archegoniatæ, Mr. N. H. Lang * discusses the two opposing theories, the antithetic and the homologous.

Prof. N. Hartog † considers the question in relation to the behaviour of the cells.

Electric Current in Plants.‡—From a series of experiments made by Herr B. Klein, mostly on Dicotyledons, he concludes that, whenever the electric current passes from the stem or leaf-stalk into the mesophyll, the current increases in strength with a diminution, and decreases with an increase of the light; the reverse being the case when the current is in an opposite direction. The blue-violet and red-yellow rays have the same effect on the current as white light.

Epiphytes upon Epiphytes.§—Herr E. Ule describes the adaptation contrivances in various species of *Utricularia* natives of Brazil, which adapt them for their habit of growth, varying from ordinary marsh-plants to those which grow only in the water receptacles or among the rosettes of leaves of other larger epiphytes, especially species of Bromeliaceæ.

Male Flower of Cycadeoidea.‖—Mr. G. R. Wieland describes the inflorescence of these fossil plants from the Mesozoic strata of the Rocky Mountains. They present a development far in advance of that of any existing Cycads, especially in the linear arrangement of the sori. This being an archaic character, most strongly marked in the Carboniferous ferns, the author considers that we have here a strong corroboration of the view that Ferns and Cycads are closely related to one another, and that the latter are descended from ancestors belonging to the Filicales.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Structure of Lycopodium.¶—Herr H. Bruchmann classifies the species of *Lycopodium* under five groups, according to the structure and mode of formation of the prothallium, viz.:—(1) Type of *L. clavatum* and *annotinum*; (2) Type of *L. complanatum*; (3) Type of *L. Selago*; (4) Type of *L. Phlegmaria*; (5) Type of *L. cernuum* and *inundatum*; the first three of which are discussed in detail.

In the first type, the colourless saprophytic prothallium, becoming green on exposure to light, has the form of a flat reversed cone with a very irregularly indented margin, bearing on its upper surface both antherids and archegones. It consists mainly of a parenchyme containing but little protoplasm, outside of which are successively an envelope of reserve-material tissue, a layer of palisade-cells, and a cortex. The cells of the cortex and palisade-layer always contain an endotrophic

* Tom. cit., pp. 583–92. † Tom. cit., pp. 593–4.

‡ Ber. Deutsch. Bot. Ges., xvi. (1898) pp. 335–46.

§ Tom. cit., pp. 308–14 (1 pl.).

‖ Amer. Journ. Sci. (Silliman), vii. (1899) pp. 219–26 (3 pls. and 2 figs.).

¶ Ueb. d. Prothallien u. d. Keimpflanzen mehr. europ. Lycopodieen. Gotha, 1898, 119 pp. and 7 pls. See Bot. Ztg., lvii. (1899) 2te Abth., p. 6.

fungus-mycele. In the prothallium of the second type there is a much more pronounced differentiation of tissues; it is small and resembles a turnip crowned by a colourless lobed crest, and bears antherids and archegones on its upper surface. The cortex contains a fungus-mycele. In the third type, the prothallium is tuber-like or elongated. colourless, and with less strongly differentiated tissues, consisting of a central part which bears the antherids and archegones, and a peripheral cortical portion. The sexual organs are surrounded by paraphyses; the prothallium has the faculty of branching adventitiously.

The author gives a full description of the development of the embryo in *L. clavatum*. The fertilised oosphere lengthens into a pear-shape before it breaks up into a larger suspensor-cell facing the neck of the archegone and a smaller embryonal cell. This latter divides into eight cells, the foot originating from the four lower ones, the shoot and the first endogenous root from the four upper. The foot remains enclosed in the prothallium; the shoot produces two opposite cotyledons. The processes are similar in *L. complanatum*. In *L. Selago* the foot is developed outside the prothallium, and only one cotyledon is formed.

The lateral roots of *Lycopodium* are not produced from the pericambium, as stated by van Tieghem and Douliot, but from the cortex.

The author then discusses the systematic position of the Lycopodiaceæ, which he thinks is not near to the Selaginellaceæ. While the structure of the sexual generation approaches that of Mosses, the structure of the sporophyte comes much nearer to that of the higher plants. The genus *Lycopodium* should be broken up into several.

Stem of Lycopodium.*—Mr. C. E. Jones classifies the species of *Lycopodium* in two groups, according to the anatomical structure of the stem:—(1) *L. clavatum, alpinum, Phlegmaria*, and *cernuum*. The oval stelic arrangement is marked by a considerable amount of xylem, broken up into patches by bands of phloem. Large empty cells, sieve-tubes, appear in the centre of these bands. Protophloems and protoxylems are external, forming a continuous ring. The cells of the cortex lying just outside, the endodermal cells are thickened and lignified, forming a third concentric zone. (2) *L. squarrosum, dichotomum*, and *nummularifolium*. The phloems occur as islands in the sea of xylem, or as inserted peninsulas; they are built up centrally, with the apparent sieve-tubes in the centre. Protoxylems are well marked and lie externally; but protophloems are not to be distinguished. *L. Dalhousieanum* and *Selago* are intermediate between these types.

Division of the Chromosomes in the Formation of the Spores of Ferns.†—The following are the main results obtained by Mr. W. C. Stevens from an investigation of this process in *Scolopendrium vulgare*, *Cystopteris fragilis*, and *Pteris aquilina*. From the original archespore there arise sixteen spore-mother-cells. The chromosomes of the first division are short and stout, differing in this respect from those resulting from vegetative division. A numerical reduction of the chromosomes takes place during the prophasis of the first division of the

* Ann. of Bot., xii. (1898) pp. 558-9.
† Ber. Deutsch. Bot. Ges., xvi. (1898) pp. 261-5 (1 pl.).

mother-cell. In the following process of the separation of the daughter-chromosomes, two types may be distinguished, according as the separation begins in the middle or at the ends, producing thus either double rods or annular chromosomes. After the separation is complete, the daughter-chromosomes collect at the poles, and there fuse into a single nuclear thread. This thread then splits longitudinally and divides transversely, as in the first division. No centrosomes could be detected, and no multipolar spindle-primordia.

Archangiopteris, a New Genus of Filices.*—Herr H. Christ and Dr. K. Giesenhagen describe under this name a fern which they make the type of a new genus of Marattiaceæ from S.W. China, somewhat intermediate between *Angiopteris* and *Danæa*, and possibly an ancestral form of the former genus. It differs from *Angiopteris* in the sori being linear, not oval, and median, not subterminal; in the larger indusium; in the sporanges being much more numerous; the frond much smaller, only simply pinnate, and with no recurrent nervules; from *Danæa* in the exarticulate stipe and rachis; in the sporanges not being coalescent into a synange; and in the presence of an indusium.

Hymenophyllum with Bulbils.†—Under the name *Hymenophyllum Ulei* sp. n., Herr H. Christ and Dr. K. Giesenhagen describe a fern from Brazil, nearly related to *H. ciliatum*, but distinguished by the presence on the rhizome of bulbils, which are composed, in their upper portion, of tufts of hairs, and apparently serve as hydathodes for the temporary storing up of water in the form of rain or dew.

Air in the Ripe Annulus-cells of Fern-Sporanges.‡—Herr J. Schrodt answers in the affirmative the question whether the mature cells of the annulus of the sporange of ferns contain air. But whether this air has penetrated through the membrane when moist or when dry is not certain. Some observations made by the author would seem to indicate that the dry membrane is easily permeable for air.

Muscineæ.

Direction of Growth of Mosses.§—Herr B. Jönsson describes in detail the effect of external agencies, especially gravity, on the growth of mosses, which arrange themselves, on this point, in various groups.

In one group, of which *Homalothecium sericeum* may be taken as the type, there are two kinds of vegetative shoot, the main and the lateral shoots. The former are adpressed to the substratum, and spread out in all directions, branching, in their lower portion, into stems with dorsiventral lateral organs. The leaves on the main shoots are generally closely adpressed to the stem, and have comparatively long apiculi. The lateral shoots are apparently arranged in pairs, and are at first adpressed to the substratum; in later stages they grow free from it, and form two parallel rows.

* Flora, lxxxvi. (1899) pp. 72–8 (5 figs.). † Tom. cit., pp. 79–85 (2 figs.).
‡ Ber. Deutsch. Bot. Ges., xvi. (1898) pp. 322–30.
§ Lunds Univ. Arsskr., xxxiv. (1898) 16 pp. See Bot. Centralbl., Beih., viii. (1899) p. 271.

In some mosses, especially in species of *Dicranum*, the leaves exhibit the same directions of growth as the shoots in those already described.

In a large number of mosses, light, which contributes to the development of the plagiotropic growth in the above-named species, has no influence on the direction of growth of the lateral shoots; positive geotropism playing the principal if not the only part. The leaves of *Dicranum scoparium* are, in the same way, positively geotropic.

While, therefore, the orthotropous mosses, represented by *Polytrichum*, owe their direction of growth chiefly to light, that of the plagiotropic species is mainly influenced by geotropism in conjunction with moisture.

Oil in Mosses.*—As the result of a large number of analyses, Herren B. Jönsson and E. Olin state that a larger or smaller amount of oil is generally present in mosses, forming, with carbohydrates and nitrogenous substances, the material for metastasis. The amount is small in those species which, like *Sphagnum*, grow in wet places, larger in the xerophilous species; in *Bryum roseum* it amounts to 18 per cent. It is more abundant in the resting condition than when assimilation is energetic. In some families, e. g. the Bryineæ, oil is the chief or the sole basis for metastasis; in the Mnieæ it is accompanied by a greater amount of starch. In *Bryum roseum* all the cells of the mature part of the stem contain oil. The medullary tissue, the central bundle, and the outer cortical tissue, are the parts where it is chiefly found.

Classification of Pleurocarpic Mosses.†—Herr N. C. Kindberg holds that, in the classification of Mosses, too much stress has been laid by systematists on the form of the capsule, which may vary even within narrow limits of affinity. From the study especially of tropical forms, he proposes the arrangement of the pleurocarpic genera under three tribes:—the Tricholepideæ, the Dicholepideæ, and the Symphyolepideæ. To the 1st belong the Cryphæaceæ, Anomodontaceæ, Fabroniaceæ, Pilotrichaceæ, and Pterobryaceæ; to the 2nd the Hypopterygiaceæ, Phyllogoniaceæ, Neckeraceæ, Leptodontaceæ, Leskeaceæ, Entodontaceæ, Hookeriaceæ, Meteoriaceæ, Eriodontaceæ, Spiridentaceæ, Cyathophoraceæ, Racopilaceæ, Helicophyllaceæ, Climaciaceæ, Mniadelphaceæ, Thuidiaceæ, and Hypnaceæ; while the 3rd tribe comprises the Fontinalaceæ only. A complete classification of the genera under these 22 families is given.

The Hypopterygiaceæ have amphigasters, while the Phyllogoniaceæ have not. The Spiridentaceæ are distinguished from the rest of the Pleurocarpæ by their sheathing leaves. In the Cyathophoraceæ the capsule is straight, the calyptra cap-shaped, and the peristome double. In the Racopilaceæ the capsule is curved, the calyptra unilateral and cap-shaped, the peristome double, and the leaves more or less papillose. The Helicophyllaceæ should possibly be placed among the Acrocarpæ. The Mniadelphaceæ are distinguished by their cap-shaped calyptra; the capsule is straight; the stem not arborescent.

Braithwaite's British Moss-Flora.‡—Proceeding with the family Hypnaceæ, Dr. R. Braithwaite has now completed his account of

* Lunds Univ. Arsskr., xxxiv. (1898) 42 pp. and 1 pl. (German).
† Bot. Centralbl., lxxvi. (1898) pp. 83–8; lxxvii. (1899) pp. 49–55, 385–95.
‡ Pt. xix., 1899, 32 pp. and 6 pls. Cf. this Journal, 1898, p. 327.

Amblystegium, and commences the large genus *Hypnum*. This is divided into 8 sections:—Myurium, Scleropodium, Panckowia, Rhynchostegiella, Rhynchostegium, Rhaphidostegium, Brachythecium, and Pleuropus. In the present part are comprised Myurium (1 species), Scleropodium (3 species), Panckowia (13 species), Rhynchostegiella (4 species), and the greater part of Rhynchostegium (7 species).

Rabenhorst's Cryptogamic Flora of Germany (Musci).*—The two most recently published parts of this work, edited by Dr. K. G. Limpricht, are still engaged with the genus *Hypnum*. Forty-six species are described belonging to the sub-genera Drepanocladus (38 species in all), Cratoneuron (5 species), Ptilium (1 species), Ctenidium (2 species), and Stereodon, which includes 23 species. Then follows a diagnosis of the subgenus Hygrohypnum, the species belonging to which will be described in the succeeding number.

Algæ.

Protoplasmic Body of Florideæ.†—Mr. R. W. Phillips gives the following description of the form of the protoplasmic body in various Florideæ. In *Ceramium rubrum* and other species, a strong strand of protoplasm runs along the axial cells from pit to pit. In this strand the nucleus is occasionally suspended; more often it lies over the pit at the base of the strand. In *Dasya coccinea* the branches of limited growth run out into pointed uncorticated filaments, the cells of which are large. Across the vacuole of these cells, running from pit to pit, occurs a thread of protoplasm, much more delicate than the corresponding structure in *Ceramium*. In *Callithamnium byssoides* threads of protoplasm radiate from a cushion lying over the pit, and end blindly on the vacuole. These threads are in incessant movement, swinging over, bending on themselves, and extending or retracting. All these phenomena seem to point to the great physiological importance of the communication between cell and cell.

Nuclear Division in the Tetraspore Mother-cells of Corallina.‡—Mr. B. M. Davis has followed out this process in the case of *C. officinalis* var. *mediterranea*. The figures present special interest, from the peculiar differentiation of the kinoplasm into two bodies of remarkable form, which takes place in metakinesis at the two poles of the spindle. These bodies the author regards as centrospheres, though no granular structure or centrosomes could be detected. They stain somewhat more deeply than the surrounding cytoplasm. The ends of the spindle-fibres reach the centrospheres, but do not penetrate them; their composition appears to be the same as that of the centrospheres. The centrospheres were not detected during the resting stage of the nucleus; their first appearance takes place during the karyokinetic prophasis; while the spindle-fibres are first apparent in the later prophases after the absorption of the nucleole. After metakinesis the chromosomes are drawn towards the poles of the spindle, and are at length crowded in close proximity to the centrospheres. After anaphasis they collect into a small ball, and

* Pts. 33, 34. Cf. this Journal, 1898, p. 327.
† Ann. of Bot., xii. (1898) p. 569.
‡ Ber. Deutsch. Bot. Ges., xvi. (1898) pp. 266–72 (2 pls.).

coalesce into a "chromatin-sphere," round which is formed the new nuclear membrane.

The nucleole is absorbed before metaphasis; in the later prophases the nucleus contains simply chromatin-bodies; the new nucleoles are clearly seen only after the second division of the nucleus. The union of the chromatin into a more or less characteristic body corresponds closely to the process in *Spirogyra.*

Reproduction of Dictyota.*—According to Mr. J. Ll. Williams, the tetraspores of *Dictyota dichotoma* are produced throughout the season; the sori are formed during neap-tides, and the spores are liberated during or immediately after the highest spring-tides. When liberated, the oospheres are not invested with walls; in this condition they strongly attract the antherozoids. If not fertilised, they lose the power of attracting antherozoids, form walls, and germinate. The author believes that the factor which determines the maturation and liberation of the sexual cells, and the fertilisation of the oospheres, is the amount of illumination to which the plants are subjected.

Agardh's Analecta Algologica.†—The 4th "Continuatio" of this important contribution to Algology treats chiefly of the following subjects:—The structure and affinity of *Cystoclonium,* which is referred to the order Dumontiaceæ of Florideæ; The structure and affinity of *Spyridia,* with a monograph of the species; the author regarding the genus as exhibiting greater affinity with the Rhodomeleæ than with the Ceramiaceæ; The structure and affinity of *Furcellaria,* presenting no close affinity with any other form; On the fertile portions of *Hydrolapathum*; On *Ballia hamulosa*; The genus *Thamnocarpus*; The species of *Microcladia*; *Erythroclonium Mülleri*; Certain species of *Delesseria*; The structure of the fruit of *Zanardinia*; The genus *Rhododactylis*; The variations in the structure of *Mychodea*; *Endogenea,* genus or subgenus; The species of *Dictymenia*; The characters of *Bostrychea,* with a synopsis of the species; The fructiferous organs of *Cliftonia*; Variations in the structure of *Nereia* (Fucoideæ); New species of *Myriodesma.*

Sexuality of the Ectocarpaceæ.‡—Herr F. Oltmanns now admits, in all essential points, the accuracy of Berthold's account of the conjugation of gametes in *Ectocarpus siliculosus*; although the process appears to occur only under peculiar conditions not yet accurately determined. The fusion may commence at any spot of the two gametes; the nuclei eventually coalescing completely; the chromatophores do not unite. The swarming bodies are of two kinds, larger and smaller; conjugation takes place only between the smaller ones; the larger ones germinate directly. The reproductive bodies of *Ectocarpus* and *Tilopteris* may be classified as follows:—

I. Unilocular sporanges, which form
  - *a.* Normal zoospores.
  - *b.* Aplanospores.
  - *c.* Monospores (Akinetes) (?).

* Ann. of Bot., xii. (1898) pp. 559–60.
† Acta Univ. Lund, xxxiii. (1897) 106 pp. and 2 pls. Cf. this Journal, 1895, p. 339.
‡ Flora, lxxxviii. (1899) pp. 86–99 (16 figs.). Cf. this Journal, 1897, p. 418.

II. Plurilocular sporanges, which form
 a. Gametes.
  α. Normal male and female gametes.
  β. Parthenogenetic gametes.
  γ. Aplanospores.
 b. Neutral swarmers.
  α. Normal swarmers.
  β. Aplanospores.

Chambers and Pores in the Cell-wall of Diatoms.* — Herr O. Müller records a number of minute observations on the structure of the siliceous valves of *Isthmia nervosa*, *Eupodiscus Argus*, and *Epithemia Hyndmanni*, and concludes with the following observations.

"The perforation of the cell-wall by pores and canals, with or without relation to areolar chambers, is a frequent phenomenon, and offers a wide field for the investigation of the finer structure of the cell-wall. But the similarity of external conformation does not necessarily imply similarity of function. It is certain that the pore-canals of *Eupodiscus* have a different function from those of *Isthmia.* The former genus has no special contrivances for osmosis; the pore-canals carry the protoplasm to the chambers which open outwards, where interchange with the external medium takes place by free diffusion. In *Isthmia*, on the other hand, there is abundant osmotic apparatus, and the pore-canals must have a different still unknown function, although the protoplasm contained in them, and possibly escaping through them, must obviously take up salts and oxygen from contact with the external medium. If, in the cases of *Eupodiscus*, *Triceratium*, *Pleurosigma*, &c., the pore-canals have a second unknown function in addition to diffusion, which, in *Isthmia*, *Epithemia*, &c., is assigned to the special pore-system, we must regard the latter as exhibiting a distribution of labour which is not displayed in the former. While *Pleurosigma* has a countless number of extremely minute chambers and pores, which give the cell-wall the appearance of a sieve, the cell-wall of *Pinnularia* is provided with large chambers opening outwards, and is nowhere perforated by pores except at the raphe. Both genera, however, have a raphe, and the presence or absence of this structure cannot therefore influence the purpose in the economy of the cell which is provided for by these contrivances."

Movements of Diatoms.†—Mr. F. R. Rowley gives a careful abstract of Lauterborn's important work ‡ on the Structure, Division, and Movement of Diatoms. The structure of the frustule of *Pinnularia major* and *Surirella calcarata* is described in detail. In the former species Lauterborn believes in the existence of an enveloping layer of hyaline jelly, so remarkably transparent, and possessing a refractive index corresponding so closely with that of the surrounding water, as to be completely invisible in clear water, even with the best lenses. The motion is probably due to very fine gelatinous threads, proceeding from the central node, and running obliquely backwards, forming an acute

* Ber. Deutsch. Bot. Ges., xvi. (1898) pp. 386–402 (2 pls.).
† Natural Science, xiii. (1898) pp. 406–16 (1 pl.).
‡ Cf. this Journal, 1897, p. 234.

angle with the surface of the frustule. These threads are also invisible in clear water. In other species of *Pinnularia*, e.g. *P. oblonga*, and in the genera *Navicula*, *Pleurosigma*, and *Nitzschia*, both the gelatinous envelope and these granular projections appear to be wanting.

Schmidt's Atlas der Diatomaceen-Kunde.—Heft 54 contains plates 213–216, and includes species of the genera *Rhoiocosphenia*, *Gomphonema*, and *Didymosphenia* (a new sub-genus of *Gomphonema*, distinguished by the end of the raphe being always clearly distinguishable in the two terminal nodes). The illustrations are marked by the usual clearness and accuracy of detail. Dr. Martin Schmidt succeeds his father as compiler of the Atlas.

Fungi.

Respiration of Fungi in different Nutrient Solutions.*—From experiments made by Herr K. Puriewitsch on the growth of *Penicillium glaucum* in various solutions, he derives the general law that the value of the proportion $\frac{CO_2}{O_2}$ increases with the concentration of the solution up to a certain optimum, and beyond that decreases. For dextrose and saccharose the optimum concentration is about 10 per cent. With tartaric acid the concentration appears to have no effect on the proportion. With water containing only a very small quantity of mineral salts, the fraction is much below unity.

Influence of Light on the Respiration of the Lower Fungi.†—A series of culture experiments on a variety of Fungi and Schizomycetes has led Herr R. Kolkwitz to the following general conclusions:—Light promotes the process of respiration, independently of the morphological conditions of the culture and of the nutrient substance. This is in direct opposition to previous results. Intense sunlight, or electric (arc) light, has a deleterious and even fatal effect on many bacteria.

Dangeardia, a New Genus of Chytridiaceæ.‡—Herr B. Schröder has found, on *Pandorina morum*, a parasitic fungus, which he makes the type of a new genus under the name *Dangeardia mamillata* g. et sp. n. The following is the diagnosis of the genus:—Intramatrical mycele unbranched, short, brush-like; sporange solitary, sessile, with smooth membrane, flask-shaped before maturity, 30 μ long by 16–20 μ broad, opening by an orifice at the apex; swarm-spores ovoid or ellipsoidal, about 2·5 μ broad, 3·4 μ long, with refringent oil-drops, and a single cilium 3–4 times as long; resting spores intramatrical, ellipsoidal, with thick papillose or spiny membrane and large excentric oil-drops, 13·6 μ long by 10·2 μ broad.

The fungus is parasitic on the spherical cells resulting from the non-sexual multiplication of *Pandorina morum*. The author places it, along with *Chytridium* and *Polyphagus*, in the order Monochytridineæ, family Sporochytriaceæ, sub-family Orthosporeæ.

Herr Schröder gives also a detailed description of the mode of non-sexual multiplication of *Pandorina morum*.

* Ber. Deutsch. Bot. Ges., xvi. (1898) pp. 290–3 (1 fig.).
† Jahrb. f. wiss. Bot. (Pringsheim), xxxiii. (1898) pp. 128–70 (2 pls.).
‡ Ber. Deutsch. Bot. Ges., xvi. (1898) pp. 314–21 (1 pl. and 1 fig.).

Penicillium as a Wood-destroying Fungus.*—Prof. H. Marshall Ward finds *Penicillium* to be a much more active organism in initiating and carrying on the destruction of wood than has hitherto been supposed; it does not arise merely as the result of the disintegration of the tissues by other Fungi.

Structure of the Hemiasci.†—From a study of the development of several genera and species of the Hemiasci—especially *Ascoidea rubescens*, *Protomyces Bellidis*, and *P. macrosporus*—Herr C. M. L. Popta arrives at the conclusion that, as far as regards the mode of spore-formation, they do not form a well-differentiated group; some genera, represented by *Ascoidea*, showing greater affinity to the Ascomycetes, others, e.g. *Protomyces*, to the Phycomycetes. In *Ascoidea*, the numerous and minute spores are imbedded in a matrix; the entire mass escaping through an opening in the apex of the sporange in long vermiform coils. In *Protomyces*, on the other hand, there is no such matrix in which the spores are imbedded; they are expelled with considerable force in a globular mass through the opening in the sporange. The fusion of spores which takes place in *Protomyces macrosporus* does not appear to be accompanied by any fusion of nuclei.

Ascoidea agrees with the Ascomycetes in its free spore-formation, leaving an unused matrix, but differs in the development of its sporange with several nuclei. In these points *Dipodascus* and *Conidiascus* agree with *Ascoidea*.

Development of the Helvellineæ.‡—Dr. G. Dittrich has followed this out, especially in the cases of *Mitrula phalloides* and *Leotia gelatinosa*. He regards the Helvellineæ as Pezizeæ with a strong growth in surface of the hymenium, the variability of their perithece probably depending partly on external conditions. The primary nucleus of the ascus is formed (in *Helvella infula*) by the fusion of two nuclei, a purely vegetative process.

The fructification of *Mitrula phalloides* presents, at its first origin, a non-sexual sterile mass of tissue formed of branched and interwoven mycelial shoots, in which the fertile elements arise as groups of cells with abundant protoplasm and large nuclei. These are pushed up to the upper part of the fructification, where the peripheral hyphæ form a mucilaginous envelope, among which the paraphyses become differentiated. This is the origin of the angiocarpous hymenium. A similar process takes place in *Leotia gelatinosa*, but here the paraphyses are already differentiated in the unstalked fructification. The paraphyses break through the envelope, while the ascogenous hyphæ beneath them branch freely. In *Helvella Ephippium* the fertile disc, which is at first hemispherical, becomes two-lobed by the strong superficial growth of the upper side. The irregular growth and strong curving of these lobes gives rise to the complicated pileus of species of *Helvella* and *Gyromitra*, and finally to the simpler forms of *Peziza*.

Biology of Parasitic Fungi.§—Herr M. Nordhausen has investigated the conditions under which *Botrytis cinerea*—under ordinary con-

* Ann. of Bot., xii. (1898) pp. 565–6. † Flora, lxxxvi. (1899) pp. 1–46 (2 pls.).
‡ Beitr. z. Biol. d. Pflanzen (Cohn), viii. (1898) pp. 17–52 (2 pls.). Cf. this Journal, *ante*, p. 65. § Jahrb. f. wiss. Bot. (Pringsheim), xxxiii. (1898) pp. 1–46.

ditions a saprophyte, but also occasionally acting as a parasite—forces its entrance into the tissues of the host-plant. Culture experiments convinced him that a substance poisonous to the host-plant is excreted in the germination of the fungus spores; this excretion takes place especially during the early stages of germination. The secretion appears to consist of two substances, one of which causes changes in the cellulose-walls, the other the death of the protoplasm. Experiments showed that the latter is not oxalic or any other organic acid, but probably an enzyme. This fungus is able in this way to attack almost any plant, and almost any part of the plant.

Similar results in the main were obtained with *Mucor stolonifer* and *Penicillium glaucum*, but the latter species does not appear in the general way to produce a poisonous enzyme.

Parasitic Fungi.—M. N. Raciborski * finds, in Java, a disease produced on *Vigna sinensis* by *Cercospora Vignæ* sp. n.; and the crops of *Arachis hypogæa* completely destroyed by a parasitic fungus, *Septoglœum Arachidis.*

Dr. J. Eriksson † has studied in detail the life-history of *Puccinia Ribis*, which he regards as a true Micropuccinia, with only one generation of spores, the teleutospores. The special form *rubri* attacks both the red and white currant, but not the black currant, and probably not the gooseberry.

Mr. J. J. Davis ‡ describes a new species of *Doassansia*, *D. Zizaniæ*, parasitic on *Zizania aquatica.*

Returning to the question of the witch-broom of the barberry, Dr. J. Eriksson § agrees with Magnus in identifying it with *Puccinia Arrhenatheri*, in which all three stages—the uredo, puccinia, and æcidium stages—are facultative.

Mr. A. D. Selby ‖ records about 20 species of Cucurbitaceæ as host-plants of *Plasmopara cubensis* in Ohio. It is not known there on host-plants belonging to any other natural order.

Dr. B. Frank ¶ enumerates the various fungi and Schizomycetes which contribute to the potato disease, viz.:—*Phytophthora infestans*, *Rhizoctonia Solani*, *Fusarium Solani*, *Phellomyces sclerotiophorus*, and a *Micrococcus* which he describes as *M. phytophthorus* sp. n., and which he regards as the only one that is certainly pathogenous; in addition to nematodes. The fungus parasites act either independently, or two or more in conjunction. A combination of *Phytophthora* and *Rhizoctonia* is especially common.

Herr C. Wehmer** describes the structure and life-history of *Monilia fructigena* (which he regards as belonging to the genus *Sclerotinia*), one of the most destructive parasitic fungi of cultivated fruit-trees, and the cause of the brown-rot of cherries.

The mildew of the apple, caused by *Sphærotheca Mali*, is described by

* Zeitschr. f. Parasitenkunde, 1898, p. 66. See Bot. Centralbl., lxxvi. (1898) p. 377.
† Rev. Gén. de Bot. (Bonnier), x. (1898) pp. 497–506 (1 pl.).
‡ Bot. Gazette, xxvi. (1898) pp. 353–4.
§ Beitr. z. Biol. d. Pflanzen (Cohn), viii. (1898) pp. 1–16. Cf. this Journal, 1898, p. 659.
‖ Bot. Gazette, xxvii. (1899) pp. 67–8.
¶ Ber. Deutsch. Bot. Ges., xvi. (1898) pp. 273–89.
** Tom. cit., pp. 297–307 (1 pl.).

Herr P. Magnus.* It is well distinguished specifically from *S. Castagnei.*

Fungus-Galls on Ferns.†—In addition to the case already observed of galls formed on *Aspidium spinulosum* by *Taphrina filicina*, Dr. K. Giesenhagen now records the formation of galls on *Aspidium pallidum* by *Taphrina fusca* sp. n., and on the same fern by *T. cornu-cervi.*

Sexuality of the Collemaceæ.‡—Herr E. Baur gives some details respecting the sexual process in the Collemaceæ (*Collema crispum*). The thallus is of two types:—the first is luxuriant and strongly developed, with no or very few apotheces; the second much smaller, and densely covered with apotheces. The former type bears abundance of carpogones; while on the latter they are comparatively rare. Whenever the whole of the trichogyne could be observed, a spermatium (pollinode) was always found attached to its tip, and orifices were observed in the wall of the trichogyne, through which the nucleus of the pollinode may have passed. A large number of ascogone-cells take part in the formation of the asci; and the author believes the actual process of impregnation to be comparable to that in some Florideæ and in the Laboulbeniaceæ. The first ascogone-cell must be regarded as the egg-cell (oosphere); the sperm-nucleus fusing with its nucleus. The posterior ascogone-cells are auxiliary cells. The impregnated ovum-nucleus divides, and a daughter-nucleus passes into each auxiliary cell.

Coalescence of the Margins of the Thallus in Crustaceous Lichens.§—Herr G. Bitter describes this phenomenon in a large number of species, and classifies the modifications of the process under the following heads:—Coalescence of the margins of individuals of the same species; this may take place with or without the formation of a separating seam (*Abgrenzungssaum*); Formation of separating seams in the coalescence of individuals of different species; Crustaceous Lichens which overgrow neighbours of a different species (foliaceous and arborescent lichens) may also be overgrown by Pertusariaceæ; Saprophytic consumption of the remains of lichens by other lichens; Pushing aside of lichens by their hypophloeodic neighbours; Parasitic Fungi which have been erroneously described as Lichens (*Karschia scabrosa, Lecidia intumescens*); Epithallinic outgrowths of Crustaceous Lichens. Behaviour of Foliose Lichens in contact with Lichens of a similar thallus-form.

Nucleus of the Yeast-Plant.—From an exhaustive investigation of this subject, Mr. H. Wager ‖ states that all yeast-cells (*Saccharomyces Cerevisiæ, Ludwigii,* and *pastorianus*) contain a "nuclear apparatus." In the earlier stages of fermentation this consists of a nucleole, in close contact with a vacuole which contains a granular chromatin network, and is probably the result of the fusion of smaller vacuoles. In the later stages of fermentation this vacuole may disappear. The nucleole is present in all cells, and is apparently a perfectly homogeneous body.

In the process of budding, the division of the nuclear apparatus does not exhibit any definite stages of karyokinesis, but must be regarded

* Tom. cit., pp. 331–4 (1 pl.). † Flora, lxxxvi. (1899) pp. 100–9 (6 figs.).
‡ Ber. Deutsch. Bot. Ges., xvi. (1898) pp. 363–7 (1 pl.).
§ Jahrb. f. wiss. Bot. (Pringsheim), xxxiii. (1898) pp. 47–127 (14 figs.).
‖ Ann. of Bot., xii. (1898) pp. 499–543 (2 pls.).

as a direct division of the nucleole into two equal or nearly equal parts, accompanied by division of the chromatin vacuole, network, or granules. The nucleole divides either in the neck joining the bud to the mother-cell, or more rarely in the mother-cell itself, one of the products of division passing subsequently into the bud. In spore-formation the chromatin disseminated through the protoplasm becomes more or less completely absorbed into the nucleole, which then divides by elongation and constriction into two. During the division, deeply stained granules appear, surrounded by a less deeply stained substance, which remains for a time connecting the two daughter-nucleoles. This may possibly indicate a simple stage of karyokinesis. Subsequent divisions take place, resulting in the formation of four (sometimes more) nucleoles. Each nucleole becomes surrounded by protoplasm and a delicate membrane; and thus are formed the spores standing free in the remainder of the protoplasm. The spores are at first very small, but they soon increase in size; the surrounding protoplasm becomes used up; the spore-membranes increase in thickness, until at last, in the mature condition, they completely fill the mother-cell.

Prof. L. Errera * also finds a relatively large nuclear body in every adult cell of *Saccharomyces Cerevisiæ.*

Alcohol-producing Enzyme of Yeast.†—From a fresh series of experiments on both high and low fermentation yeasts, Prof. J. R. Green is led to modify to some extent his previous conclusions, and to agree with those of Buchner ‡ as to the production of an alcohol-producing enzyme. When the yeast-cells are active, they secrete an enzyme which can be extracted by appropriate means, and then sets up fermentation in sugar solutions under conditions which prevent the activity of living yeast. The enzyme is easily decomposed, and its secretion by the cell is intermittent, taking place only during actual fermentation by the yeast.

Sorghum Blight and Yeast Parasitism.§—By infecting sorghum with different kinds of yeasts, M. Radais has demonstrated that yeasts can develop in the living cells of sorghum, and that the parasitism of these yeasts is capable of exciting a deep red staining of the tissues of the plant. This staining is quite the same as is observed in the disease called sorghum blight. The pigment is therefore the production of the diseased cell, and the parasite is only indirectly concerned therein. These results confirm the hypothesis of Palmeri and Comes, and are not opposed to the views expressed by Burrill, Kellermann, and Swingle. They amount in fact to the statement that the red coloration is the result of the chromogenic function of the diseased cells, and that this staining may be caused by diverse parasites, yeasts or bacteria. On the other hand they are opposed to the conclusions of Bruyning, who attributed the phenomenon to chromogenic bacteria.

Organisms isolated from Cancer, and their Pathogenic Effects on Animals.‖—Mr. H. G. Plimmer isolated from a cancer an organism

* Tom. cit., pp. 367–8.
† Ann. of Bot., xii. (1898) pp. 491–7. Cf. this Journal, 1898, p. 219.
‡ Cf. this Journal, 1897, p. 414. § Comptes Rendus, cxxviii. (1899) pp. 445–8.
‖ Proc. Roy. Soc., lxiv. (1899) pp. 431–6.

having many resemblances to Blastomycetes. The medium used was made from cancer after the manner of beef infusion, and after having been neutralised, 2 per cent. glucose and 1 per cent. tartaric acid were added. Anaerobic environment was adopted for the cultivations. The liquid medium becomes cloudy, and the growth deposits a sediment. Subcultures were made on agar-gelatin and potato. The growth at first is white, becoming yellow or yellowish brown later on. Microscopically, it consists of round bodies invested with a strongly refractive capsule, sometimes showing a double contour. There is a deeply staining nucleus. The diameter varies from 0·004 mm. to 0·04 mm. Reproduction takes place by budding.

Morphologically, these bodies corresponded with those found in the original tumour, and with those described by numerous observers in cases of cancer.

Successful inoculations were made on rabbits and guinea-pigs. In the viscera were numerous metastatic deposits just as in cancer.

Myxomycetes.

Pseudocommis Vitis.*—M. J. Debray treats at great length of this destructive parasite, which, though most frequent on the vine, attacks also many other plants,—of its structure and life-history, of the changes which it brings about in the tissues of the host, and of the treatment of the disease. He finds it also as an accompaniment of the "sereh" of the sugar-cane, often associated with a gummy secretion, and in the root-tubercles of Leguminosæ. The author describes four different forms which the plasmode may assume, in addition to the spherical cysts.

Protophyta.

β. Schizomycetes.

Internal Structure of Bacterial Spores.†—By adopting a special method of staining, Dr. G. Catterina has demonstrated the existence of a central body in the anthrax spore. This central body is to be regarded as a nucleus. When the spore develops, the central body becomes rod-shaped, and is disposed in the long axis of the spore, and when the latter divides, the central body does so too. By the method adopted the spore may be double-stained, and it also imparts the notion that the membrane is not uniform.

Similar appearances were observed in the spores of *B. anthracis symptomatici*, *B. megaterium*, and *B. subtilis*.

Microbes of Flowers.‡—M. D. Freire, by making cultivations from the carpels and stamens of flowers, and more particularly the stigmas and anthers, has detected the presence of numerous micro-organisms. Some of his experiments are recited, and contain short descriptions of new species of microbe.

(1) *Hibiscus rosa sinensis*. From the anthers of the flower was cultivated *Micrococcus cruciformis* sp. n., the colonies of which on gelose

* Bull. Soc. Bot. France, xlv. (1898) pp. 253–88 (2 pls.). Cf. this Journal, 1898, p. 224.
† Atti Soc. Veneto-Trentina, iii. (1898) pp. 429–37.
‡ Comptes Rendus, cxxviii. (1899) pp. 1047–9.

were the colour of egg-yolk. Gelatin is liquefied slowly, the cavity produced having a punched-out appearance. The reaction of the gelatin becomes acid, and from the medium is exhaled a peculiar acrid odour. In bouillon, which at first becomes turbid, a white sediment is deposited. The coccus is 1 μ in diameter, is frequently grouped in pairs, and is easily stained.

(2) Rose (var. Rothschild). From the corolla was obtained in liquid and solid media *Leptothrix ochracea* Kütz.

(3) *Rosa gallica* (*centifolia*). This furnished (*a*) a coccus morphologically resembling *Streptococcus pyogenes*, and (*b*) a bacillus designated *Bac. gallicus* sp. n. This bacillus, 2–3 μ long, is characterised by the formation of tough colonies on gelose, by their almost black colour when large, and their ball-like appearance in thrust cultures. It does not liquefy gelatin. Bouillon becomes turbid, and a white sediment is deposited.

(4) *Ipomæa Quamoclit* L. (Cardinal) furnished two species, one having the characters of *M. salivarius pyogenes*, and the other those of *Spirillum plicatile*.

(5) From the blossom of *Persica vulgaris* typical growth of *Bac. pyocyaneus* was obtained.

The author suggests that pathogenic and saprophytic microbes may find an asylum on flowers, from which they may afterwards depart to finish their career on more suitable animal or vegetable hosts. The correspondence of colour between the colonies of the parasite and the hue of the host is commented on, and allusion is made to osmogenic microbes or such as reproduce odours similar to those disengaged by the flowers.

Ferments of Vine-diseases.*—Further investigation of the causes which lead to *casse* or bitterness in wines, has led M. J. Laborde to the general conclusion that the microbes of bitter wines must be classed among aerobic forms either complete or more or less facultative; while those of sound or turned wines belong indifferently to the aerobic or anaerobic class. The mannitic ferment of Gayon and Dubourg † must be placed under the former head.

Production of Fluorescent Pigment by Bacteria.‡—Mr. E. O. Jordan, in his investigation as to the production of fluorescent pigment, used six different bacteria. The special conditions investigated were the influence of the chemical composition, of the concentration, and of the reaction of the medium, and the influence of light upon pigment production. From his experiments he concludes that:—(1) The presence of both phosphorus and sulphur is essential to the formation of fluorescent pigment. (2) The nature of the base associated with the phosphorus and sulphur is unimportant. (3) The following is a list of compounds examined, given in order of fluorescigenic value:—Asparagin; succinic, lactic, citric, tartaric, uric, acetic, oxalic, formic acids. (4) The presence of acid in the medium not merely conceals the existence of the substance to which the colour is due, but interferes with the vital activities of

* P.-V. Séances Soc. Sci. Phys. et Nat. Bordeaux, 1898, pp. 149–55. Cf. this Journal, 1898, p. 456. † Cf. this Journal, 1894, p. 373.
‡ Bot. Gazette, xxvii. (1899) pp. 19–36.

the bacilli which in an alkaline solution lead to the production of that substance. (5) Diffuse daylight is unfavourable to pigment production. (6) Excess of certain substances which in themselves are favourable to growth and pigment production, checks pigment production, but does not interfere with growth.

The author expresses his own opinion as follows:—that "since the pigment is of no discoverable advantage to the organisms possessing the power of producing it, its production is probably purely accidental and not an essential vital act. The 'fluorescigenic function' is simply the expression of certain changes wrought by the organism upon the substratum on which it lives. When the substratum contains certain compounds, the metabolic activities of the organism adjust themselves to these conditions, and the metabolic products differ correspondingly. It is purely a matter of accident, and of no physiological significance, that under certain conditions one of these metabolic products happens to be fluorescent."

Micro-organisms in Dunedin Water.*—Mr. A. G. Kidston-Hunter found an average of 30 non-pathogenic organisms per ccm. in Dunedin water; no pathogenic species were detected by any of the methods used. The principal organisms were:—(1) *Bacillus aquatilis fluorescens.* This is an aerobic short slender bacillus with rounded ends. The colonies resemble a fern-leaf with a lustre of mother-of-pearl. The gelatin is not liquefied. (2) The yellow bacillus. This exhibits in gelatin-tube cultures a yellow thread-like growth, which penetrates the medium in a lateral direction and liquefies it slowly, causing a funnel-shaped cavity wherein is deposited a golden-yellow slime. On gelatin-plate cultures the colonies are small, oval with serrated edges, and of a golden-yellow colour. (3) The orange-red water bacillus. This is a very slender bacillus, aerobic, does not liquefy gelatin, and forms on the surface of the medium red granular-looking colonies.

Pathogenic Sarcina.†—Dr. Loewenberg isolated a sarcina from the secretion in the nasal fossa of a person suffering from ozæna. The sarcina is non-motile. It stains well and also by Gram's method. It grows well on the usual media. The optimum temperature is incubation heat. When tartaric acid was added to nutrient media, no growth ensued. The most suitable media were liquid; and though growing well in milk, this liquid was not coagulated and remained alkaline.

While in the original source the arrangement of the aggregates was typically cubical, in the solid cultivation media this was irregular, in groups or in chains. In the liquid media the grouping was typical.

The sarcina is a potential anaerobe, and does not produce gas or odour. It is distinguished from other sarcinæ by being pathogenic to guinea-pigs, white mice, and rabbits.

New Butyric Acid Bacteria.‡—Herren A. Schattenfroh and R. Grassberger have found butyric acid bacteria in milk by heating a quantity for five minutes to half an hour in a steamer, and incubating the closed vessel at 37° C. By the next day lively fermentation had

* Fourth Intercolonial Med. Congress, Dunedin, 1896, 7 pp.
† Ann. Inst. Pasteur, xiii. (1899) pp. 358–64.
‡ Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 209–11.

occurred, the casein had separated out and had been carried to the surface by the gases developed. When the vessel was opened, there was a more or less distinct odour of butyric acid. The fermentation was found to be associated with the presence of three kinds of anaerobic bacteria, of which two were probably merely varieties of the same species. These two were motionless, while the third was motile and flagellated. All three stained by Gram's method; they fermented milk-sugar, grape-sugar, and starch, but not lactic acid; they are essential anaerobes, and form butyric acid freely. Milk is strongly fermented, with evolution of gas. Casein is separated in lumps, but is not peptonised. Two of them liquefy gelatin. The non-motile species which does not liquefy gelatin forms a small quantity of inactive lactic acid. The other two form dextro-lactic acid.

Bacillus icteroides.*—Dr. E. London examined a virulent culture of *B. icteroides*, sent by Sanarelli to Prof. Lukjanow. Sanarelli's description is on the whole confirmed, though the author disputes certain details, and while agreeing that the organism is pathogenic, is of opinion that its specific relation to yellow fever is not yet proved.

Effect of small Quantities of Glucose on the Vitality of Bacteria.†—Dr. F. E. Hellström finds that the addition of glucose in the proportion of 0·1 for cholera, 0·2 for typhoid, and 0·3 for other kinds of bacteria to simple bouillon (2 l. water to 1 kg. meat) without pepton, and with a neutral or faintly acid initial reaction, exerts within a few days a deleterious action, owing to the medium turning acid.

When the medium contains a still smaller quantity of nutritive material, a less amount of glucose suffices to bring about a fatal effect; and conversely, when the amount of nutritive substance is greater, a larger amount of glucose is required to exert a pernicious action.

A small quantity of glucose in bouillon is favourable to the increase of essential aerobes, and this amount of glucose stands in direct relation to that of the nutritive material in the bouillon.

Micrococcus phytophthorus.‡—Prof. Frank states that the cause of potato rot is *Micrococcus phytophthorus*, and that the black disease of the stems is also due to the same organism. *M. phytophthorus* is easily cultivated on gelatin, and does not liquefy the medium. It is about 0·5 μ in diameter. As a rule it occurs singly, but diplococci and short chains are not rare. It is found chiefly between the cells. Pure cultures inoculated on healthy plants reproduced the disease.

Bacteriosis of the Leaves of Oncidium sp.§—Dr. V. Peglion states that *Oncidium* leaves are sometimes attacked by a disease which makes them fleshy, stiff, and cylindrical; they are traversed by four deep furrows, and covered with violet-brown spots. When the disease is more advanced the tissue softens, and a liquid is produced. In this fluid are multitudes of micro-organisms (1·30–1·5 $\mu \times$ 0·8–1 μ). From this fluid cultures were obtained on agar plates and also on bean decoction to which had been added saccharose and some bicarbonate of soda. The latter fluid was also used as solid medium by adding 2 per cent. agar.

* J.A. Journ. Russ. Gesellsch. f. Gesundheits., 1898. See Beih. Bot. Centralbl. viii. (1899) pp. 375–6.
† Centralbl. Bakt. u. Par., 1[te] Abt., xxv. (1899) pp. 170–80, 217–23.
‡ Op. cit., 2[te] Abt., v. (1899) pp. 98–102, 134–9 (3 figs.) § Tom. cit., pp. 33–7.

The colonies are white or slightly yellowish, and at first exhaled a fruity odour which was eventually replaced by the disagreeable smell of putrefaction.

Inoculation of healthy plants with pure cultures reproduced the disease. The organism is designated *Bacterium Oncidii*.

Mode of Action of Bacillus subtilis in the Phenomena of Denitrification.*— Mdlle. A. Fichtenholz cultivated *Bacillus subtilis* in an artificial medium composed of nitrate of potash 5 parts, phosphate of potash 1·25, sulphate of magnesia 0·0125, calcium chloride 0·0125, glucose 12·5, water 1000, and soda in quantity sufficient to render the medium slightly alkaline. At a temperature of 38–39°, and with free access of air, *B. subtilis* developed in this medium with normal morphological characters. Soon after the formation of the zoogloea scum, ammonia appeared in the fermentation liquid.

Thus *B. subtilis* is able to develop in an artificial medium which contains only nitric nitrogen, and this development is associated with ammoniacal fermentation. The quantity of ammonia formed varies with the stage of fermentation. In the first few hours there is none; after reaching its maximum it decreases.

Chromogenic Oxydase secreted by the Coli bacillus.†—According to M. G. Roux, the coli, and indeed other bacilli, possess the property of forming pigment through the intermediary of the diastase secreted by them.

The diastase in question, more properly designated oxydase, owing to its special function, was studied under two conditions. In the first experiment, laccase and artichoke gelatin were mixed. The mixture gradually assumed an olive-green hue, while the control tubes remained unaltered. In the second series, ordinary pepton-gelatin containing a minute quantity of hydroquinone was inoculated with coli bacillus. The medium soon became brown, and by the end of the third week was of a mahogany-red hue. The control tubes remained unchanged. The production of this pigment is due to an oxydase which can only act in the presence of oxygen, but is not affected by the absence of light.

The foregoing observations were led up to by Roger's experiments with the coli bacillus on artichoke. On this medium coli cultures produce an emerald-green pigment, and also, as was found by the author, on artichoke-gelatin.

Bacillus cadaveris sporogenes.‡—Mr. E. Klein describes a bacillus, met with in the intestinal contents of man and animals, which in shape and size closely resembles the bacillus of tetanus. The organism, designated *B. cadaveris sporogenes* (*anaerobicus*), is an essential anaerobe, produces gas, is motile, and forms terminal spores. It rapidly liquefies sugar, gelatin, and coagulated blood-serum; it is not pathogenic to animals. The typical bacillus is a straight rodlet 2–4 μ long, and these rods may grow into quite long filaments. In each bacillus there may be an oval spore, 1·6–1·8 μ long and about 0·8–1 μ broad. The bacillus is provided with tufts of long thin wavy flagella. Both the vegetative and

* Comptes Rendus, cxxviii. (1899) pp. 442–5.
† Tom. cit., cxxviii. (1899) pp. 693–5.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 278–84.

spore forms are easily stained by fuchsin, methylen-blue, or both, and by Gram's method. Under anaerobic conditions the bacillus is easily cultivable, especially on grape-sugar gelatin, with the production of much gas, the medium being also rapidly liquefied. Milk is coagulated, and from it arises a disagreeable odour, the reaction being amphoteric or slightly alkaline. On blood-serum at 37° C., growth is rapid, and the formation of spores copious and early. This early production of spores in blood-serum is one of the chief features which distinguishes it from *B. enteritidis sporogenes*.

The author regards *B. cadaveris sporogenes* as the principal cause of the putrefaction of dead bodies.

Grass bacillus ii.*—Under this name Dr. A. Moëller describes a bacillus obtained from vegetable refuse. The author's communication is really a contribution to the pleomorphism of bacteria, and deals with an organism belonging to the tubercle bacillus group which is resistant to acids and alcohol, and which exhibits true branchings. It is easily cultivable, and grows well on the ordinary media. Like the bacilli of dung, of timothy grass, and of tuberculosis, it is quite resistant to the action of acids and of alcohol, and especially so if the cultures be young. It stains by Gram's method. The bacteria are motile when young. The majority are 1–5 μ long and 0·2–0·4 μ broad. They are usually bent, sometimes Y-shaped, and on glycerin-agar there are long branched and unbranched filaments.

Pure cultures injected into the peritoneal sac of guinea-pigs cause death in 4–6 weeks, with appearances indistinguishable from those of tuberculosis.

The most distinctive characteristics of this *Grass bacillus ii.* is the frequent occurrence of true branchings. Like the other two tuberculoid bacilli, it was found on vegetable substrata.

Contagium vivum fluidum, the Cause of Spotted Disease of Tobacco Leaves.†—Herr M. W. Beijerinck, who has for a long time been investigating the cause of the spotted or mosaic-disease of tobacco leaves, has come to the conclusion that the malady is not due to microbes but to a contagium vivum fluidum. When passed through a porcelain filter, the juice of a diseased plant, though devoid of bacteria, anaerobic as well as aerobic, is found to retain its infective properties.

That it is a virus fluidum as opposed to fixum, i.e. not containing corpuscular or morphotic elements, is shown by its diffusibility through agar plates, as well as by the fact that cultivations are always sterile.

The virus attacks only those tissues and organs which are in an active condition of growth and of cell-division. It may gain entrance either through the leaves or the roots, and appears to be chiefly conveyed along the course of the phloem. The virus may be dried, and may pass the winter in the soil, without losing its infective power; even the alcoholic extract, dried at 40°, is virulent. It is quite destroyed by boiling.

In the milder form of the disease, the virus chiefly attacks the chlorophyll granules, but in severer cases the whole of the protoplasm is affected. In the mild cases the leaves seem, in the earlier stage, as if

* Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 369–73 (1 pl. and 5 figs.).
† Verhand. Konink. Akad. Wetensch. Amsterdam (2de Sectie), Deel vi. No. 5, 22 pp. (2 pls., coloured).

spotted over with dark-green patches which later on become brown or orange-brown. In the severer cases, especially from artificial infection, the leaves become malformed and monstrous. In some of the experiments the absence of chlorophyll was noted, and this defect was found to be due to the association of a bacterium, *Bacillus agglomerans*, with the virus.

The author concludes his interesting observations by alluding to other infectious diseases of plants due to a contagium fluidum.

Immunity to Arsenic Compounds.*—Dr. Besredka's second memoir on immunity to arsenic compounds deals with the leucocytic reactions in the different forms of arsenical intoxication, and with the faculty possessed by the white corpuscles of englobing or rather of absorbing the arsenic injected in a soluble condition. The reactions of the leucocytes vary according to the resistance of the animals, and therefore with the dose of the poison and with the accustomedness or non-accustomedness of the animal to the poison.

The injection of arsenic is always followed by hypoleucocytosis, and this, if the animal survive, by hyperleucocytosis. There is no hyperleucocytosis, or only a transitory and abortive one, if the dose be fatal. Chemical analysis of the leucocytes shows that they contain arsenic only when the animal survives. Hyperleucocytosis or positive chimiotaxis is associated with englobement or absorption of the poison and by survival of the animal. Therefore there exists, in regard to a soluble toxic product, a phagocytosis having exactly the same character as for microbes or insoluble poisons.

Soil Bacillus of the Type of B. megaterium.†—Mr. C. W. Sturgis isolated from clayey and gravelly soil a bacillus $3 \cdot 4–7 \cdot 7\ \mu \times 1 \cdot 2–1 \cdot 5\ \mu$. It occurs as isolated rods or as long chains. Though normally aerobic, it is a potential anaerobe. It has a preference for acid media, and in media containing carbohydrates a thick firm gelatinous sheath is formed. Gelatin is liquefied. The temperature limits are from 10° to 35° C. It peptonises milk without coagulating it. On agar the growth is flat, circular, tawny in colour, and emits an odour like melted glue. Spores are produced in 22–70 hours, according to the temperature and the medium. The cytoplasm condenses at one pole, and there produces a spore $2–2 \cdot 8\ \mu \times 0 \cdot 8–1\ \mu$. The spore germinates at one end in a direction parallel to the longer axis. The subsequent growth of the chains is intercalary as well as terminal.

The long forms are non-motile, while the rods and short chains, especially when young, and at temperatures between 23° and 33°, exhibit lively movements.

Involution forms arise in old cultures, or in those made at low temperatures. The organism is non-pathogenic, does not produce gas or pigment, and stains readily with carbol-fuchsin, gentian-violet, or by Gram's method.

Micrococcus zymogenes.‡—Mr. W. G. MacCallum and Mr. T. W. Hastings found a hitherto undescribed micrococcus in a case of acute

* Ann. Inst. Pasteur, xiii. (1899) pp. 209–24. Cf. this Journal, *ante*, p. 197.
† Proc. Roy. Soc., lxiv. (1899) pp. 340–2.
‡ Centralbl. Bakt. u. Par., 1^te Abt., xxv. (1899) p. 384.

endocarditis. The organism was obtained from the blood during life, and post mortem was isolated from the vegetations on the aortic valve, and, from infarcts in the spleen and kidneys. It is a small micrococcus, and cultivated on agar media, shows considerable resemblance to *Diplococcus lanceolatus*. Like the latter it is easily stained by Gram's method, but is distinguished therefrom by liquefying gelatin and coagulated blood-serum, and more especially by its action on milk, which it acidifies, coagulates, and finally converts into a clear fluid by its peptonising power. It is pathogenic to white mice, rabbits, and dogs. An acute vegetative endocarditis was excited in a dog which had been intravenously injected after the cusps of the aortic valve had been artificially damaged. From these vegetations pure cultures of the coccus were obtained. Filtered cultures, which therefore contained no bacteria, peptonised milk, gelatin, &c. Owing to this ferment action the authors have designated the microbe *M. zymogenes*.

Non-motile Hog-Cholera Bacillus.*—Prof. Th. Smith mentions the discovery of a bacillus isolated from an animal dead of hog-cholera. Except that it is devoid of motility, it exactly resembles in all its other characters hog-cholera bacillus *α* described by him in 1885.† This discovery proves that there is a race of non-motile hog-cholera bacilli; and this conclusion is strengthened by the fact that hog-cholera serum agglutinates these bacilli just like the motile races.

Streptococcus of Broncho-pneumonia.‡—According to the observations of Dr. G. Catterina, a *Streptococcus* is of frequent occurrence in certain kinds of broncho-pneumonia. It is cultivable only in liquid media, wherein it forms long undulating chains. It is but little resistant, and dies in 6–8 days. It is stained well with anilin dyes and by Gram's method. It is pathogenic to white mice and rabbits. Its virulence is increased by successive transferences through animals, and is well preserved in Marmorek's serum. Sterilised cultures injected into rabbits up to 35–40 ccm. render the animal immune. Rabbits vaccinated against *Str. equi*, *Str. pyogenes*, or *Str. erysipelatis*, are not immune to this streptococcus. Indeed vaccination with *Str. erysip.* predisposes to a more rapidly fatal infection with *Streptococcus pneumonicus*.

Pathogenic Agent of Hydrophobia.§—M. E. Puscariu has found in sections of the nervous system of men and animals dead of hydrophobia, appearances which lead him to believe that he has discovered the pathogenic agent of this disease. The sections were stained with hot methylen-blue by Nissl's method, decolorised in anilin-alcohol, then in absolute alcohol, and, after having passed through origanum oil, were mounted in balsam. In sections thus stained globular formations varying in size from 7–50 μ were observed in considerable numbers, chiefly in the lymphatic spaces, but also in nerve-cells. When stained with methyl-violet they gave the amyloid reaction; when unstained they were yellowish and refracting. The granulations or formations are composed of blue-stained bacilli, mostly 2–3 μ long and 0·4–0·6 μ broad, with

* Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 241–4.
† Cf. this Journal, 1895, p. 1052.
‡ Atti Soc. Veneto-Trentina, iii. (1898) pp. 438–48.
§ Comptes Rendus, cxxviii. (1899) pp. 691–3.

rounded ends. Other bacilli are longer, 6–8 μ, and these have one swollen end like the clubs of *Actinomyces*. Indeed the general arrangement is strikingly like that of *Actinomyces*, though no mycele was made out.

Ætiology of Leukhæmia.*—Prof. M. Löwit communicates the more important results of his observations on leukhæmic blood. In myelæmia there is a leucocytic hæm-amœba which he proposes to call *Hæmamœba leukhæmiæ magna*. Multiplication takes place in the blood by means of spores, as in acystosporous sporozoa. In blood-forming organs spores having the characters of resting spores can be demonstrated; but whether there is a proliferation through chromatozoits (crescents) is not yet determined.

In lymphæmia the parasites are rare in the peripheral blood. In the blood-forming organs another parasite, *Hæmamœba leukhæmiæ vivax*, is found both in the cytoplasm and in the nucleoplasm. In cases of mixed infection both parasites are to be found. To certain animals the leucocytic infection can be transferred from man and also from animal to animal.

Morphology of Glanders Bacillus.†—Dr. H. Marx has observed in cultures of glanders, forms with bulbous swellings, branching forms, buds and filaments of varying shape and size. The preparations were taken from potato, carrot, and gelatin cultures. The author considers that these branchings indicate the relationship of glanders bacillus to *Actinomyces*.

Bacterium from Diabetic Urine.‡—Herr G. Marpmann has detected the constant presence of a bacillus in the urine of persons suffering from alimentary diabetes. The bacillus is from 1·5–2 μ long and 0·2–0·3 μ broad. Attempts to cultivate on agar at blood-heat failed. The bacillus was not found in cases of traumatic or nervous diabetes.

Ætiology of Epidemic Conjunctivitis.§—Dr. L. Kamen has had an opportunity of observing an epidemic of acute conjunctivitis which attacked the garrison at Czernowitz. He is of opinion that it was caused by the Koch-Weeks bacillus. Pure cultures were most easily obtained on Pfeiffer's blood-agar. Morphologically and biologically, the bacillus appears to belong to the influenza group. It is extremely perishable and but little adapted to a saprophytic existence, as is shown by the difficulty of obtaining subcultures and their rapid decay on artificial media. It seems to be little, if at all, pathogenic to animals.

Bacillus from Relapsing Fever Blood.‖—Dr. S. M. Afanassiew has found in the blood of relapsing fever patients (17) a bacillus as well as the spirillum. The bacilli were always found during the fever. In the early stage (first day) they are small (1–1·5 μ × 0·3 μ) with rounded ends; later they became longer, 5–6 μ, and sometimes filaments 10–14 μ were observed. In every field 3–30 individuals were present, and it was noticed that the spirochætæ, as well as the bacilli, were invested with a non-staining sheath. Cultivations were obtained in bouillon,

* Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 273–4.
† Tom. cit., pp. 274–8 (4 figs.). ‡ Tom. cit., pp. 306–8.
§ Tom. cit., pp. 401–5, 449–57 (3 pls. and 14 figs.).
‖ Tom. cit., pp. 405–15 (5 figs. and 10 charts).

gelatin, agar, blood-serum, potato, &c. In bouillon the bacillus grew from 1 μ at first to 6 μ later on, and was extremely motile. Growth on gelatin, which was not liquefied, was white. The rodlets from these plates were long, and pointed at both ends. In grape-sugar bouillon long chains of coccus forms developed.

Injection of cultures into rabbits was followed by a rise of temperature lasting several days, and the bacillus was found in the blood, though cultures could not be obtained therefrom. Spirochætæ were not found in the rabbit's blood. Three men were injected with 0·2 ccm. of a one day old bouillon culture. All three had pyrexia, and one had two recurrences at intervals of ten days. In one case numerous rodlets and some filaments were found in the blood.

MICROSCOPY.

[The Publication Committee of the Journal has decided on resuming the issue of the Microscopic Bibliography, which was dropped on the lamented death of Mr. John Mayall, jun. It is intended in future to give at least the title of every work or paper (commencing from January 1st, 1899) coming under the head of Microscopy A or of Technique 3 (Microtomes); and we shall be much obliged to any of our Fellows who will call our attention to any such papers or articles published in Journals which are likely to escape our notice.—Editor.]

A. Instruments, Accessories, &c.*

(1) Stands.

Two Old Microscopes.—At the meeting held on May 17th the President called attention to two old Microscopes which had just been presented to the Society. The first, which was given by Mr. J. M. Offord, was signed "Adams," and was a very interesting model, which filled up a gap in the historic collection of the Society's cabinet (fig. 72). The history of the Microscope stand might be divided into three epochs. The first might be called that of the telescope mount, because the stage was quite disconnected from the body, and the Microscope was pointed to the object in precisely the same way as a telescope. Hooke's and Hertel's models are examples of this type. The second epoch began with John Marshall's Microscope in 1704. This Microscope had its body and stage attached to a limb, the limb having a joint at its lower end, where it was attached to the foot. In this class may be put all non-inclinable Microscopes, as they are evidently the same as the type when the Microscope is used in a vertical position. Examples of this class: John Marshall's; Benj. Martin's large Microscope, both being in the collection; the non-inclinable Continental modern stand; and the small Microscopes sold in toy shops. The Microscope of the third kind, which is the model chiefly used at the present time, was designed by an anonymous nobleman, and made by Adams in 1771. In this instrument the body, stage, and mirror were fixed to a bar, which was attached by a joint to the top of a pillar. The joint was of the quadrant rack form, actuated by an endless screw, in fact an adaptation of the Gregorian telescope mount common at that date. There have of necessity been variations in details; the cumbersome rack joint has been superseded by the compass joint; the pillar and flat tripod have been replaced by either the Powell tripod, or the Continental horseshoe foot, or the bent claw foot; but nevertheless the principle remains the same, and this model has slowly but surely thrust out all other forms.

The point to which the President called special attention is that we have hitherto found no Microscope, description, or figure of this last class of Microscope between the time it was invented, in 1771, and 1797, when it was adopted by Jones, the successor to Adams. We have here, however, a signed example by Adams which proves that this form of Microscope was made prior to 1797. It is true that a similar instrument

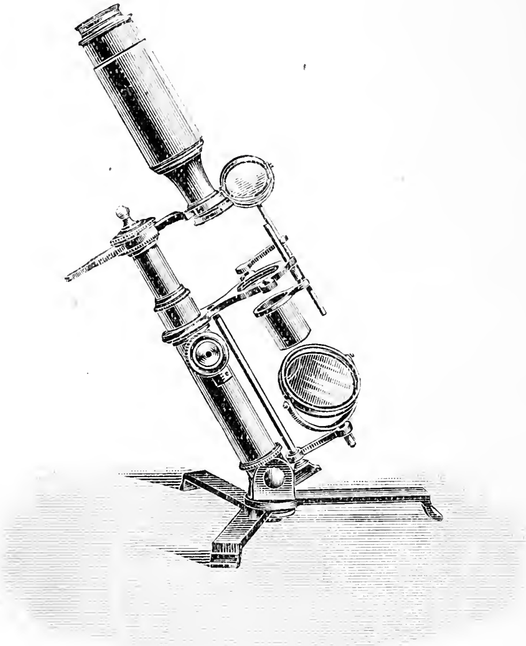
* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

(class 3) is figured in Rees' Cyclopædia, 1819, and called "Benjamin Martin's Microscope"; but it is highly probable that this is only a trade term; for we have no other evidence that Benjamin Martin adopted this construction. Benjamin Martin died in 1782, and the late and finest example of his work which is in the collection of the Society, is of class 2. This Microscope, whose probable date is about 1785–95, is the earliest type we have of class 3, which is that of the modern Microscope.

Fig. 72.

A second Microscope (fig. 73) has been very kindly presented by Dr. Dallinger. It is of class 2, and conforms very closely to a model made by Benjamin Martin in 1776. Unfortunately it is not signed, but the workmanship of the Microscope is evidently of that period, and might well be Martin's work. It will be seen at once that we have here a model of some importance; for it will be noticed that it is a body focusser, in contradistinction to the stage focussers so prevalent at that date. The following is a brief description:—The pillar is hinged at the bottom to a folding tripod; a tube can be extended out of this pillar for about an inch by means of rackwork; from this rack tube a third one may be pulled out for a distance of two or three inches; there is a line drawn vertically down this third tube, and a mark engraved on the second tube; when this line is opposite the mark, it indicates that the body is in a line with the centre of the stage. Here the pulling or pushing tube acts as the coarse, and the rackwork as the fine adjustment. The stage is fixed, but both "forward" and "motion in arc" over the stage are given to the body. These motions of the body over the stage were derived from Ellis's Aquatic Microscope, made by Cuff in 1755, and were highly thought of at that time. The last Microscope so fitted was one designed by Mr. W. Valentine, of Nottingham, and made by Andrew Ross

FIG. 73.



in 1831. The motion in arc was however not given up until later, and to a partial extent still survives in Powell's No. 1.

With regard to the optical portion of this instrument, we find an elaborate eye-piece. It will be remembered that it was pointed out in the description of a Benjamin Martin Microscope last year,* that the eye-lens was broken up into two lenses of equal foci, the first being a crossed, and the other a plano-convex lens. In this one we have a further development; for the plano-convex lens is again broken up into two plano-convex lenses of 3 in. foci. The equivalent focus of these three eye-lenses is 1 in., that of the field-lens 3 in., and the

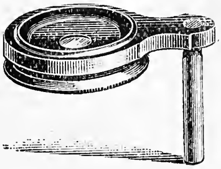
* Cf. Journ. R.M.S., 1898, p. 474, fig. 81.

distance between them 2 in. So we have here a most complicated form of Huyghenian eye-piece, consisting of no less than four lenses.

A short distance from the end of the nose-piece we have an equi-convex lens of $5\frac{1}{2}$ in. focus; this, as was stated before, is really the back lens of all the objectives; for when the power is changed it is only the front lens of the objective that is altered. These front lenses, which are six in number, are mounted in a well-made and convenient rotating nose-piece, (A rotating nose-piece of a cumbersome form was made by Adams in 1746, and was fitted to his "Universal Double Microscope.") This compound Microscope consists therefore of six lenses, the largest number probably ever fitted to a non-achromatic Microscope.

There is another piece of apparatus of much interest, viz. a ring with a bar fixed at right angles to it. This can be used for either sub-stage or superstage illumination. For substage illumination a biconvex lens, of 2 in. focus, is burnished into a short piece of tube which screws into the ring; the bar attached to the ring slides through a socket in the stage (see fig. 73), the whole forming a crude substage condenser capable of being focussed. When superstage illumination is required, the lens and its tube are removed, and a lieberkuhn substituted for them; the rod is inserted in the socket in an opposite direction, so that the lieberkuhn is brought immediately over the object on the stage. It will be noticed that the one lieberkuhn is made to do duty for all the powers (fig. 74).

Fig. 74.



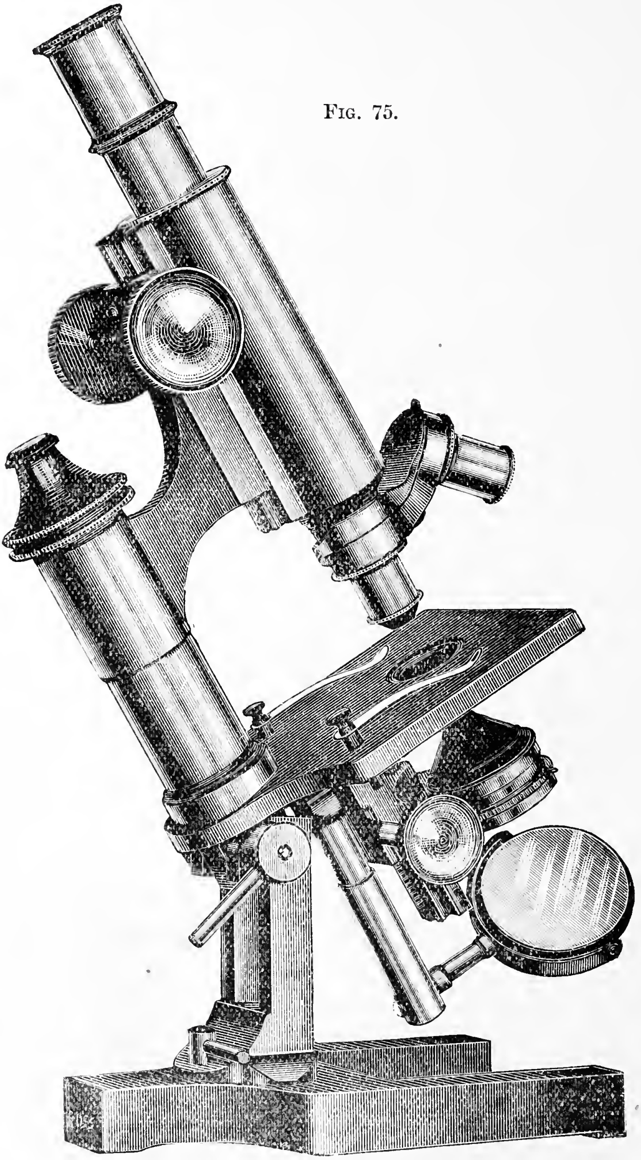
This combined sub- and superstage illuminator was employed by Jones in his "Most Improved Compound Microscope," and is figured in the 1798 edition of Adams on the Microscope, but this is the earliest example yet recorded of it. The pivoted superstage, with three holes in it, which was fitted to all Benjamin Martin's Microscopes, and which was also adopted by Adams and Jones, is unfortunately missing, but a place is fitted to receive it in the packing in the box.

Some possessor of this instrument has been trying to compensate the non-achromatism of the objective by the use of a screen; for there is a piece of green glass roughly cut to fit the tube of the substage condenser. This must be a very early, if not the earliest, instance of a screen.

The Microscope presented to the Society by Dr. Dallinger is full of interest, and is the earliest example of a rackwork limb Microscope in its collection.

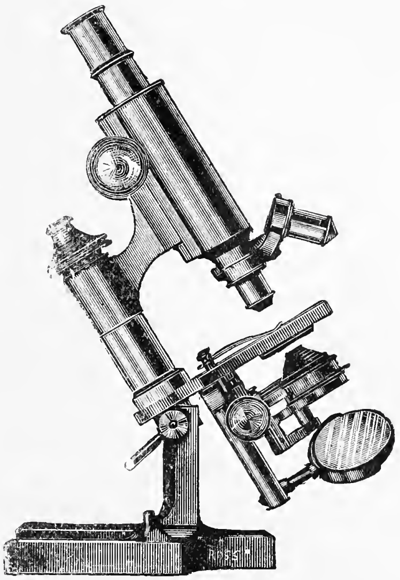
Ross's New Model Medical School and Educational Microscope.—This instrument (figs. 75 and 76) has been specially designed for the use of demonstrators, teachers, and medical, dental, veterinary, and pharmaceutical students. It is a modification of the well-known Ross Eclipse stand, and is intended to provide students, at the outset of their career, with a thoroughly good instrument at a small initial outlay, but admitting of subsequent addition of parts without structural alteration, and rendering it ultimately capable of doing the most advanced work. Its construction is substantial, and all its different parts are well fitted, and it will be found perfectly steady in all positions, even when used with the highest power objectives. The stage is sufficiently large to bring into the field of view every portion of a bacteriological cultivating trough, being $2\frac{1}{2}$ in. from centre to pillar. An entirely new but simple

Fig. 75.



device has been applied to the substage for the manipulation of the Abbe condenser and iris diaphragm independently of each other. By this means they are readily removed out of the optic line, thus effecting a great saving of time. The foot of the instrument can be made to reverse and lock, so as to bring the longest spread under the body-tube, when the instrument is to be used in a horizontal position for photography or drawing.*

FIG. 76.

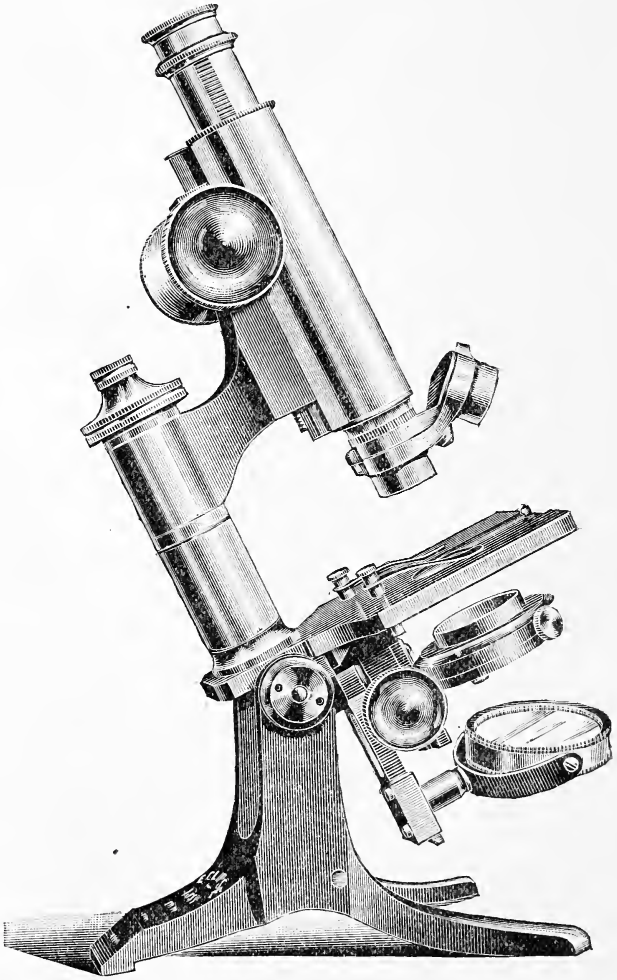


Ross's New Bacteriological Microscope.—This Microscope (fig. 77) has been specially designed for bacteriological study, and is one of the steadiest ever constructed for this purpose. The inclination to tilt, prevalent in many stands, is obviated by mounting on a patent modified tripod foot or a circular foot. This patent tripod gives a much greater spread than the ordinary tripod, but requires less space in the packing case, because the hind toe is made to fold forward between the two fixed front toes when not in use. The circular form of foot has the short stout pillar, supporting the upper part by a substantial knee-joint, situated towards the margin of the ring, which brings the whole weight centrally upon the foot when the instrument is in the upright position. When inclined, the centre of gravity is again brought directly over the foot, by rotating the pillar upon a reliable fitting at its base, so that absolute steadiness is secured. This is maintained with the body and limb in the horizontal position, so that the Microscope is particularly well adapted for photomicrography. The stage is firmly fixed between

* This principle of the reversing foot was invented by Cuff, *circa* 1765 (see Journ. R.M.S., 1898, p. 675, fig. 117); it was used by Andrew Ross in 1842 (Journal, 1899, p. 215, fig. 47), adapted to a horseshoe foot by Sidle and Poalk in America in 1880 (Journal, 1880, p. 523, fig. 39), and by Maclaren here in 1884 (Journal, 1884, p. 111, fig. 9.)—ED.

two main parts, and its aperture is of the horseshoe form, which affords convenient space for the finger to lift the slide, so as readily to bring the oil in contact when an immersion lens is used. This stage is provided, at desire, either with clip springs or a sliding dovetail clip with rectangular divisions.

Fig. 77.



The fine adjustment is of the most solid construction, and yet is extremely sensitive, and is so made that it is entirely covered at all points, thus preventing the possibility of injury by dust. The micrometer screw works directly in the centre of its fitting, and its milled head reads to 1/500 in. The draw-tube is graduated to millimetres.

The instrument is fitted with a new centering substage, having both coarse and fine adjustments; so that when using high powers with the Abbe condenser, the most accurate focus can be obtained with the least amount of trouble.

Bausch and Lomb's Continental (Grand Model) Microscope.—The large body-tube of this instrument (fig. 78), especially constructed to permit a large cone of light to pass from the objective, fits this stand especially for photomicrography. The base, of horse-shoe type, is extra heavy, and has the back claw prolonged so as virtually to form a tripod base, which is entirely stable in any position of the Microscope. The stage is of unusually large size, measuring 126 mm. in diameter, and is fitted either with a vulcanite plate or a mechanical stage; in either case the stage is revolving, and with centering screws, whereby the geometrical centre of the stage may be made to coincide accurately with the optical axis of the objective. The heads of the centering screws are provided with graduations and index, and with a series of lines recording the number of revolutions of the screw. It is claimed that these extra graduations make this the only Microscope provided with revolving mechanical stage, with which it is possible to record accurately the position of any given object, in such a manner that it can be referred to again if the instrument shall have been used *ad interim* for other work. The mechanical stage is readily interchangeable with the plain revolving stage. To effect the change, it is merely necessary to loosen the centering screws and substitute one stage for another.

The fine adjustment is an improved triangular bar adjustment; and in order to give increased delicacy in manipulation, the head of the micrometer screw is made extra large, and has a concavity at the apex in which to rest the index finger for greater steadiness. The circumference is graduated to 100 parts, permitting measurement of the thickness of objects under observation.

The coarse adjustment is by diagonal rack-and-pinion, the advantage of the diagonal teeth being that much greater delicacy of movement is secured, together with greater lasting qualities, as three teeth engage at all times, and with a shearing contact, instead of in the jarring fashion as with the straight rack. The sleeve carrying the draw-tube is removable when using the stand for photography.

American Type Microscope.—Fig. 79 represents Messrs. Bausch and Lomb's "Universal" pattern of this instrument. A large bronze pillar, jointed for inclination, is fitted on a brass tripod base, and a heavy thumb-screw (not shown in the figure) secures the instrument in any desired position. The coarse adjustment is by diagonal rack-and-pinion of long range. The fine adjustment is by micrometer screw, working in a steel nut on the triangular bearing of the arm. The head of the micrometer screw, silvered and graduated, is provided with an indicator. The main tube has two graduated draw-tubes sliding in the cloth-lined main tube. The stage has concentric revolving motion and removable spring clips. The large-sized mirrors are plane and concave; both these and the substage with its dome diaphragm are separately adjustable on their respective bases; the circular bearings of these are large, and are graduated to degrees and silvered. Mirrors and substage bars have

Fig. 78.

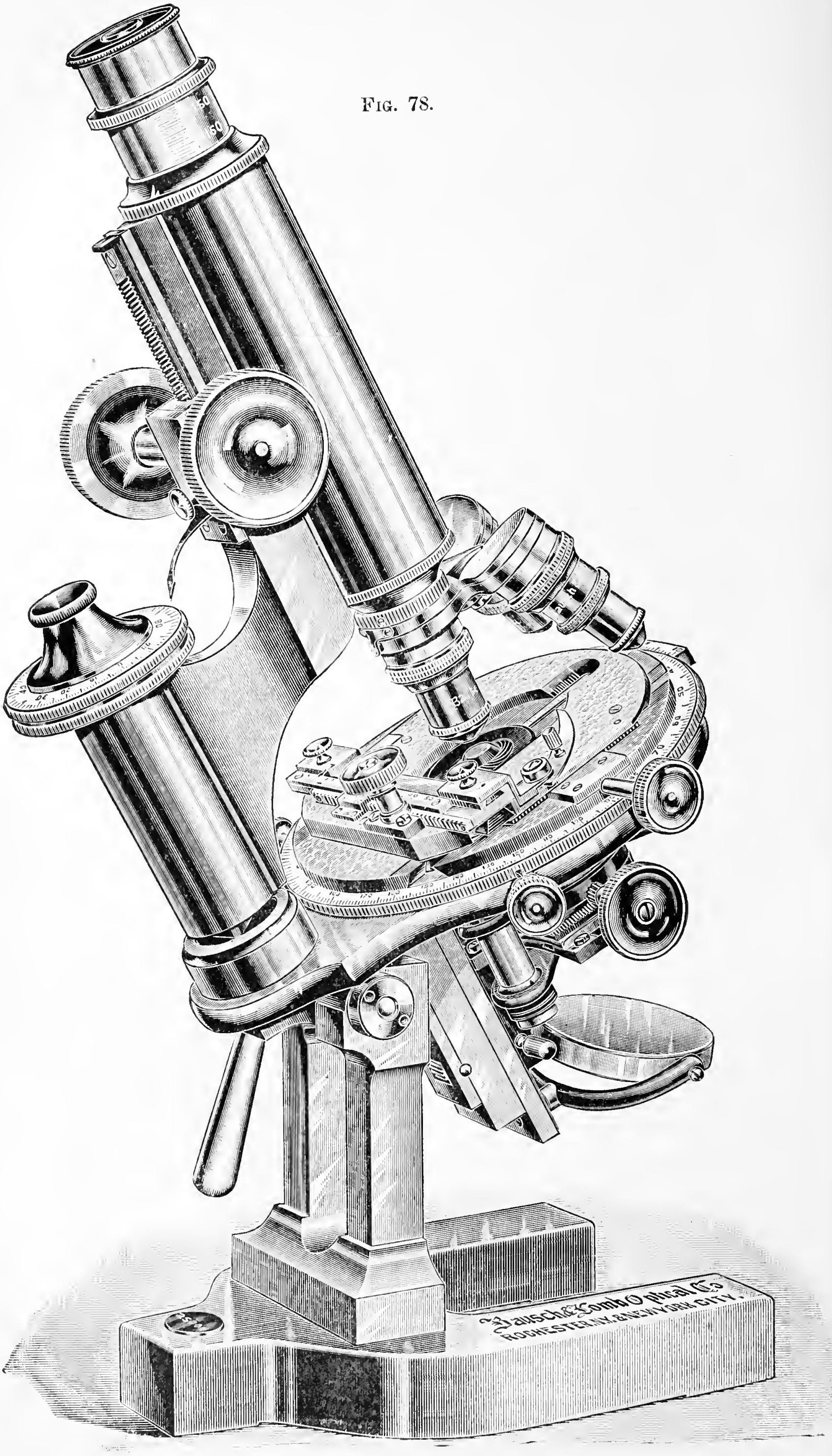
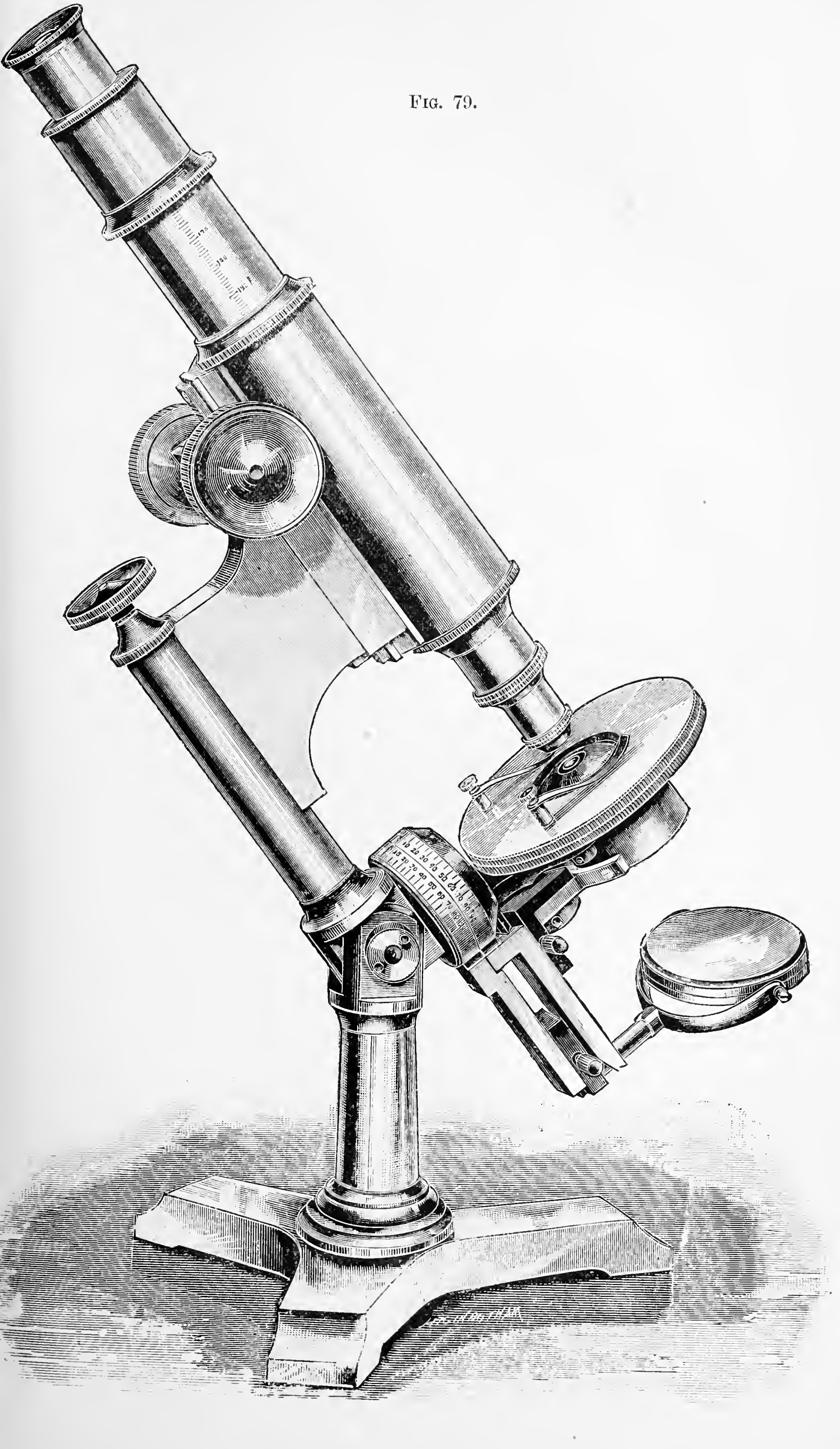


FIG. 79.



their axes in the plane of the stage, and move independently of one another or together, to any obliquity below or *above* the stage. A steel pin for centering the substage accompanies the instrument.

Sayre's Pocket Dissecting Microscope.—Figs. 80 and 81 show the instrument sold under this name by Messrs. Bausch and Lomb. It consists of a palm-piece or handle, of such length that the lens and object to be examined can be held comfortably and easily in one hand, while the other hand is left free to dissect the object, or to spread out its parts. The arm or post is cylindrical, is very light, and is so hinged and socketed that it can be placed in any position and turned at any

Fig. 80.

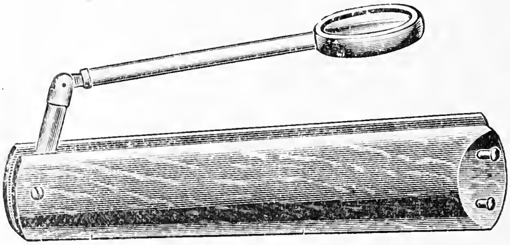
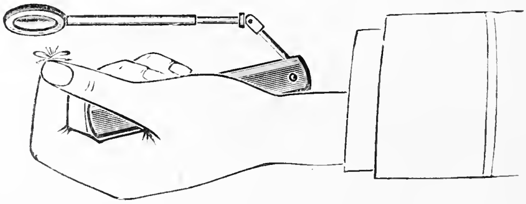


Fig. 81.



angle. The lens is of excellent quality, and is inserted upon a small post about the length of the palm-piece, so as to allow it to be placed over the object examined, when held between the thumb and forefinger of the hand which holds the Microscope. The instrument will also lie firmly on the table, as the handle is provided with a thin piece of metal which, when turned at right angles to the handle, supports it and the lens in an upright position. Thus the instrument can be used for low-power dissections. The arm and lens can be folded into the groove in the palm-piece, when the instrument resembles a pocket-knife.

Bausch and Lomb's Attachable Mechanical Stage.—Figs. 82 and 83 represent a new mechanical stage, which the designers believe will prove capable of preserving its delicacy of adjustment even after prolonged wear and tear.

The rectangular movements are both by rack-and-pinion, as all efforts to produce a perfect worm-screw movement have been unsuccessful. The rack-and-pinion is preferable, as it is perfectly reliable as to wearing qualities, is more sensitive than the screw, and gives equal speed to both movements. Millimetre graduations, with verniers, are

FIG. 82.

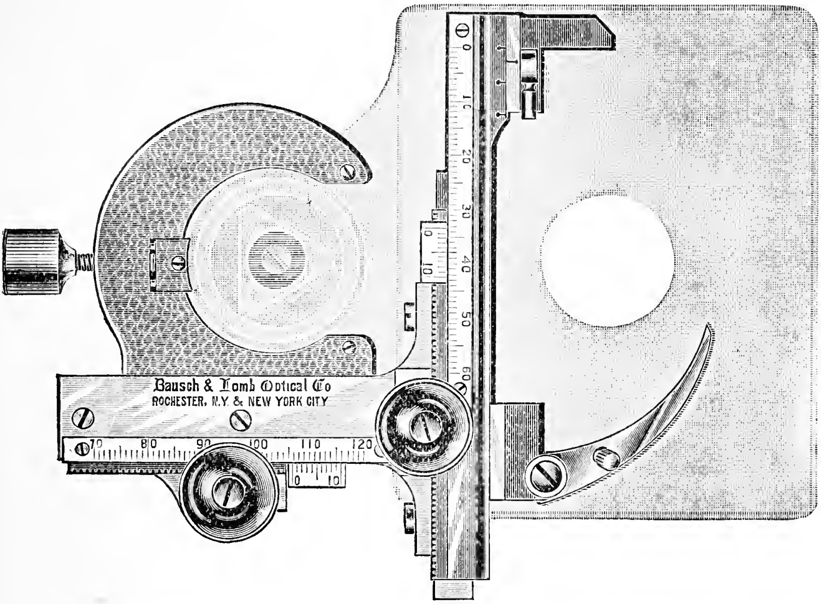
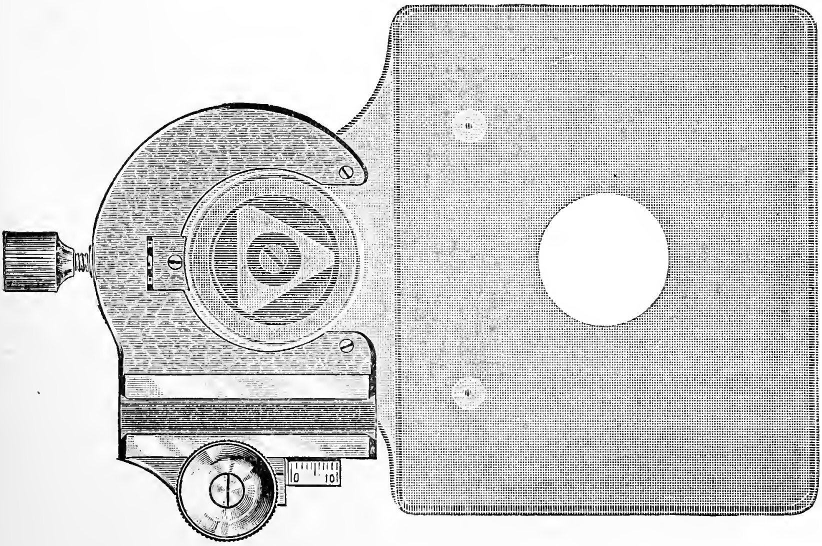
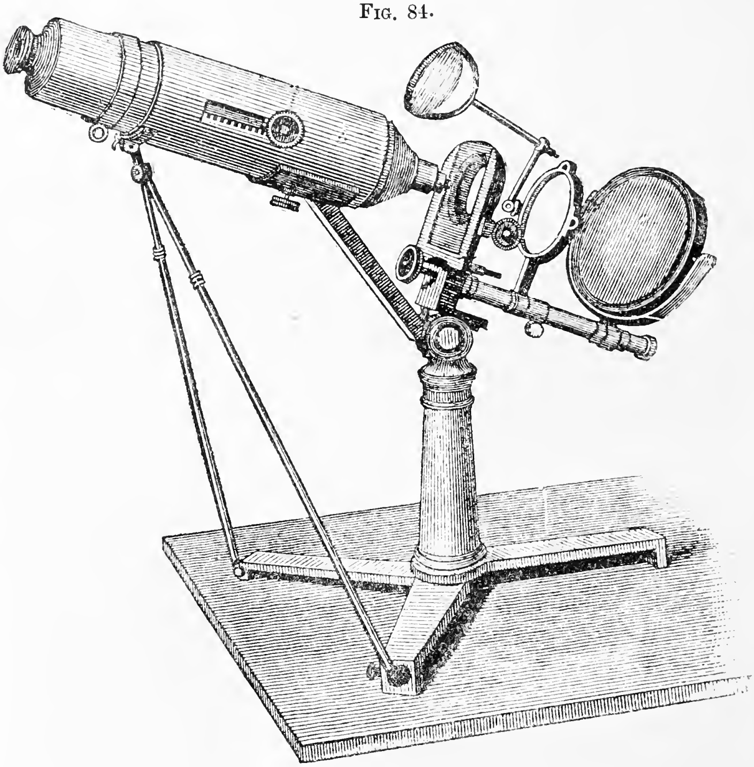


FIG. 83.



attached to both movements. The object-carrier is so arranged that the slide rests upon the surface of the Microscope-stage, and may be used in immersion contact with the condenser if desired. The stop against which the slide rests is adjustable, permitting the use of slides of various sizes. The object-carrier has an extraordinary range, the movements being 35 and 60 mm. respectively. The stage is held in place on the Microscope by a solid metal clamp, open at one side, which slips upon the base washer of the arm of the Microscope, in such a manner that the simple tightening of the thumb-screw at the back locks it immovably. The clamping device may be left attached to the Microscope permanently, and the object-carrier removed by simply racking it out of the slide. This feature is of great value, as the mechanical stage is necessary for search work, counting, &c., while an unobstructed stage is required when examining bacterial cultures in culture dishes, using watch-glasses on the stage of the Microscope, &c.

Fig. 84.



Powell's Iron Microscope.—The President sends us the following addendum to the account of Powell's Iron Microscope, which was exhibited at the February meeting *:—" I have found the origin both of the

* See p. 209 and figs. 44 and 45 of the current volume of the Journal.

peculiar shaped foot and of the joint at one side of the pillar. These constructions first appeared in a 'single-lever Microscope,' designed by C. Varley, and made by H. Powell in 1843. The gold Isis medal of the Society of Arts was presented to C. Varley for this Microscope. We are now able to place the date of Powell's Iron Microscope between the above date, 1843, and 1848, when the first published account of it appeared; the date therefore given in my original communication was too early.

"The accompanying block (fig. 84) unfortunately arrived too late for insertion in its proper place on p. 211 of the last number of the Journal. It is a cut of an important Microscope; as it is the first compound *achromatic* Microscope made in this country. It was made by Mr. Tulley from original drawings supplied by Mr. J. J. Lister, and it was completed on May 30th, 1826. It is of interest to note that the substage held a combination of lenses, or what we should now call a chromatic substage condenser."

GATES, DR. ELMER.—**Million-fold Magnification.**
[This is stated to be obtained by use of low-power lenses, and by substituting a second Microscope for the ocular of an ordinary Microscope.]
Amer. Mon. Micr. Journ., XIX. pp. 189–202 (1 pl. and 1 fig.).

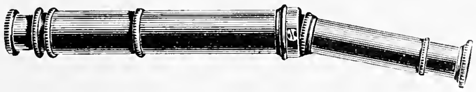
VAN HEURCK, DR. H.—**Étude sur les objectifs apochromatiques.**
[The form of lens figured in this paper is that of the old apochromats when they were first introduced, and not that of those now manufactured.]
Ann. Soc. Belge de Microscopie, XXIII. (1899) pp. 41–73 (1 pl. and 9 figs.).

WALLACE, DR. JAS.—**Eye-piece for photographing through the Microscope.**
Micros. Bull. (Philadelphia), 1899, p. 8 (1 fig.).

(3) Illuminating and other Apparatus.

Direct-Vision Spectroscope.—This small direct-vision spectroscope (fig. 85) has been sent to us by Mr. C. L. Curties. It is on a new model, inasmuch as the eye-piece is jointed; this permits a large amount of dispersion to be used together with a high-power eye-piece.

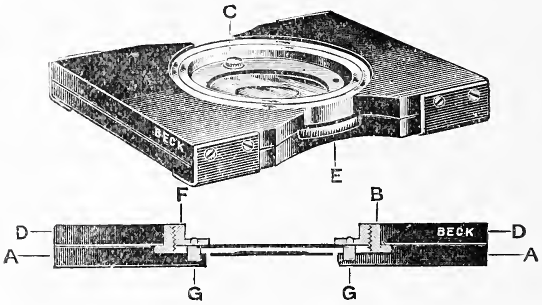
FIG. 85.



By means of the joint the spectrum can be searched low down in the red and high up in the violet, so that the A and H lines can be brought into the middle of the field. The slit is of very good quality, and the sodium lines are shown sharply divided. It is in every way suitable for microscopical work, and can be readily adapted to an eye-piece.

Davis' New Ebonite Reversible Compressor.—This instrument (fig. 86), manufactured by Messrs. Beck, is specially designed for the examination of living objects, and consists of a lower ebonite plate A, which in the centre has a circular hole recessed to receive a circular brass ring B, resting loosely in the recess. On the recessed portion of A is carried an oblong thin glass held in position by two screws, one of which appears at C. Two end plates D D slide on to the plate A, and hold the ring B loosely in position, allowing it to be revolved by means of its milled flange, which projects at E. Within the ring B is screwed a brass disc F, which carries the upper thin glass, and which

Fig. 86.



is attached by the screws G G. The screws G G and C fitting into holes in the lower plate A, and the disc F respectively, prevent the disc from revolving; and, when the ring E is turned, the two thin glasses are moved toward or away from one another.

The slides D D and the ring B, together with the disc F, are removed for arranging the object on the lower cover glass; and when replaced, by revolving the ring at E, any desired amount of compression may be obtained. The object having been arranged, either side may be examined with equal facility, as the compressor is reversible.

When a very small object is to be examined, a small circular cover glass should be cemented with Canada balsam to the lower cover-glass, and the object is thus confined to the centre of the field.

Fig. 87.

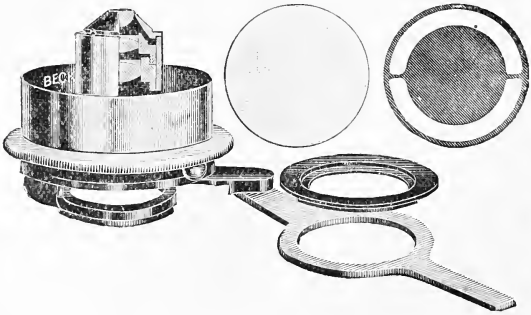
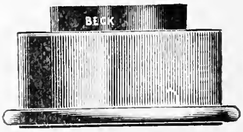


Fig. 88.

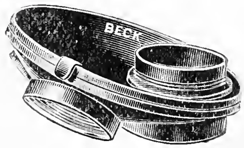


Beck's Achromatic Condenser.—This piece of apparatus is designed as a well-corrected condenser suitable for the most delicate high-power investigation. It has an aperture of 1·00 N.A., or the maximum that can be obtained without having the front of the condenser in immersion contact with the under surface of the slide. It has an aplanatic aperture of 0·90 N.A., that is to say, the whole of the light included in 0·90 N.A. is brought accurately to a point. The front lens is removable to make a low-power condenser. In the mount (fig. 87) the optical portion may be used as shown, or may be unscrewed and screwed into the bracket provided for the purpose at the bottom of the mount, and the whole condenser reversed. An iris diaphragm and a swinging arm with rotating fitting for coloured glasses or stops are provided.

The condenser may also be supplied at a cheaper rate in a plain mount with iris diaphragm, as shown in fig. 88.

Beck's New Triple Nose-piece.—This is shown in fig. 89. Its great advantage is its dust-excluding properties, and it is also low-priced. The material throughout is bright lacquered brass, and the nose-piece is accurately centered, and is so constructed that no dust can enter the back of object-glasses when left in position continuously on the Microscope.

FIG. 89.



The Rational Use of Dark-Ground Illumination.*—Dr. Gebhardt, in this paper, points out the neglect by scientists of dark-ground illumination, although he admits that botanists not infrequently use it. He thinks that this neglect is partly due to the incompleteness of the methods hitherto in vogue, notably to the deficiency of application of objectives of moderately large aperture. He points out that it is now possible, on the basis of the means furnished by Abbe's illuminating apparatus, almost even without further aids, to render objectives of high aperture serviceable to dark-ground illumination. The method depends principally on the fitting of suitable diaphragms to the objectives. But, without special occasion, no stopping-off of dry objectives ought to occur, while with immersions it is always necessary.

After numerous experiments with Zeiss' apochromatics, it was ascertained that the optimum image was got for the aperture 0·30 with a stopping-off of about 0·10 to 0·15; for aperture 0·65 with about 0·20–30; and that these afforded a sufficient penetration and flatness of the field, without the aperture becoming too much reduced for most purposes which require this flatness. With the aperture 0·95 two different diaphragms proved the best, one of about 0·30 and another of 0·60–70, according to whether it was desired to lay more stress on the flatness of the field or on the aperture. With achromatics similar proportions were obtained. With all objectives a considerable gain in light results from the water (or better the oil) immersion connection of the upper condenser-lens with the under side of the object-slide. With strong objectives of 0·70 upwards this is unattainable, if the full opening ought to be used, and in working with them the uniform use of a very intense light (e.g. sunlight) is advised.†

* Zeitschr. f. wiss. Mikr., xv. (1899) pp. 289–99 (3 figs.).

† This device is not new. Stops were fitted to objectives for this purpose by Wenham, circa 1850, examples of which are in the Cabinet of the Society.—ED.

KEELEY, E. J.—**Neglected Feature in the Construction of Achromatic Condensers.**
[The author suggests the employment of a correction collar with an achromatic condenser. A condenser with adjusting collar has been designed by Mr. E. M. Nelson, and described in this Journal, 1895, p. 230, fig. 32.]
Micros. Bull. (Philadelphia), 1899, pp. 5–6.

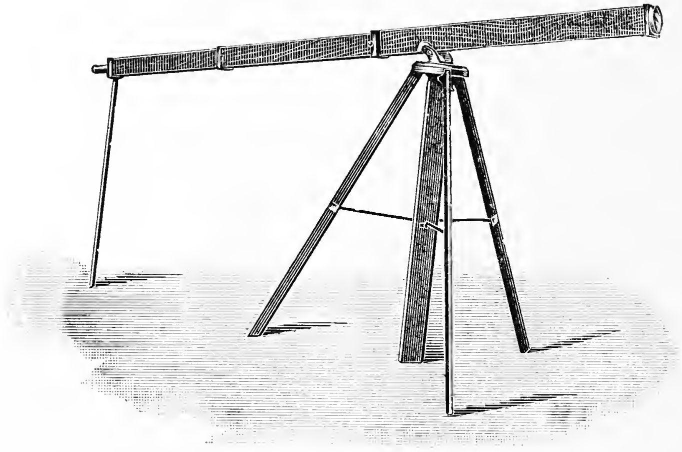
„ „ **Some simple Methods for producing Vertical Illumination.**
Micros. Bull. (Philadelphia), 1899, pp. 7–8.

(6) Miscellaneous.

Early Achromatic Telescope.—The President has sent us fig. 90, and the accompanying description of a very early achromatic telescope in his possession made by John Dollond.

This telescope is interesting from the circumstance that the achromatism of the Microscope was derived from that of the telescope. The telescope was first achromatised by Mr. Chester Moor Hall in 1733, but he appears to have kept the invention to himself, as he did not publish anything about it.

FIG. 90.



Achromatism was independently discovered by John Dollond, a Spitalfields silk-weaver, who studied mathematics and optics, and who gave up the weaving business in 1752 to join his son Peter Dollond, an optical instrument maker in Vine Court.

John Dollond, in 1757, investigated the laws of dispersion, and the next year the Copley Medal of the Royal Society was awarded to him for his invention of achromatism. As John Dollond died in 1761, the date of this telescope may be placed between the years 1758 and 1761.

It is 4 in. in aperture, and 10 ft. in focus. The body is composed of three square mahogany tubes, which slide one within the other; there are spring bolts fixed to two of them which shoot when the tubes are either fully extended or quite closed. The eye-piece is a Huyghenian, with a push tube focussing; the power is 100.

The stand is somewhat peculiar. In the centre of the tripod there is a vertical triangular box, from which extends a long triangular ratchet bar; at the upper end of this bar a rotating brass head is fitted; this holds the trunnions of the telescope. The weight of this triangular ratchet bar, together with that of the telescope, is counterpoised by three weights attached to catgut lines passing over three pulleys at the top of the triangular box. The great focal length of the telescope renders it necessary that its point of support should be considerably raised above the level of the ground.

The object-glass is still in excellent condition, and it yields a sharp and well-defined image.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Method for Making the Three Principal Artificial Media.†—Mr. H. W. Hill, in the following table, gives directions for making nutrient media based on the recommendations of a bacteriological committee.

		Boil 30 grm. thread agar in 1 litre of water for half an hour. Make up loss by evaporation to a weight of 1000 grm. Cool and solidify.
NUTRIENT BROTH.	NUTRIENT GELATIN.	NUTRIENT AGAR.
1. Infuse lean meat twenty hours with twice its weight of distilled water in refrigerator: Say 1000 grm. meat. 2000 grm. water.	Ditto.	Infuse lean meat 20 hours with its own weight of distilled water in refrigerator. Say 1000 grm. meat. 1000 grm. water.
2. Make up weight of meat infusion (and meat) to original weight by adding water, i.e. to 3000 grm.	Ditto.	Ditto, i.e. to 2000 grm.
3. Filter infusion through cloth to remove meat.	Ditto.	Ditto.
4. Titrate and record reaction of filtrate. Say reaction + 2·2 per cent.	Ditto.	Ditto. Say reaction + 4·2 per cent.
5. Weigh infusion. Say 1800 grm.	Ditto.	Ditto. Say 900 grm.
6. Set infusion on water-bath, keeping temperature below 60° C.	Ditto.	Ditto.
7. Add peptone, 1 per cent., 18 grm. Add salt, 0·5 per cent., 9 grm.	Ditto, and sheet gelatin, 10 per cent. 180 grm.	Add peptone, 2 per cent., 18 grm. Add salt, 1 per cent., 9 grm.

* 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, &c.; (6) Miscellaneous.

† Journ. Applied Microscopy, ii. (1899) pp. 301–4.

Nutrient Broth.	Nutrient Gelatin.	Nutrient Agar.
8. After ingredients are dissolved, titrate; reaction probably + 2·3 to + 2·5.	Ditto; reaction probably + 4·0 to + 5·0	Ditto; reaction probably + 4·5 to + 4·7.
9. Neutralise (Fuller's method).	Ditto.	Ditto.
		To the 900 grm. of meat infusion (containing now peptone and salt also) add 900 grm. of the 3 per cent. agar jelly described at head of this column. Since agar is neutral, the reaction is unchanged.

10. Heat over boiling water (or steam) bath 30 minutes.
11. Restore weight lost by evaporation to original weight of filtered meat infusion, i.e. that on which the percentage of peptone, salt, &c., were calculated—1800 grm. in *each case*.
12. Titrate—reaction probably + 0·3 to + 0·5.
13. Adjust reaction to final point desired—generally to + 1·5 per cent.
14. Boil 5 minutes over free flame, with stirring.
15. Add water, if necessary, to make up loss from evaporation to 1800 grm.
16. Filter through absorbent cotton, passing the filtrate through the filter repeatedly until clear.
17. Titrate to determine whether or not the desired reaction has been maintained.
18. Tube and sterilise.

Preparation of Nutrient Agar.*—Dr. T. Yokote recommends the following method for making nutrient agar, on the ground that no special apparatus is required, and that the procedure is rapid and easy. 500 grm. of minced or scraped meat free from fat or gristle are immersed in 1 litre of pure water, and the mixture thoroughly shaken up. The vessel is then placed on a sand-bath and heated at first slowly, and afterwards boiled for 1½ hours. The fluid is then filtered through paper. To 1 litre of the filtrate 15 grm. of powdered agar are added, and the mixture heated anew for about an hour, after which 10 grm. peptone and 5 grm. of salt are added. When thoroughly dissolved, the solution is treated with soda or caustic soda until it has a faint though distinct alkaline reaction. When it has cooled down to 50°, the whites of two eggs are added, and the whole thoroughly well shaken. The mixture is then heated for 1½–2 hours, care being taken that the temperature of the sand-bath near the flask is not less than 110° C. During this time the water lost by evaporation must be replaced. The next step is to strain the solution through an ordinary filter. The time occupied by filtration need not exceed 5 minutes, and the time for the whole procedure should not exceed 6 hours.

Nutrient Starch Jelly.†—Dr. E. F. Smith recommends a medium of which the following are the ingredients. (1) Three grm. of dried potato-starch are put in a test-tube along with 10 ccm. of the following

* Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 379–80.
† Op. cit., 2te Abt., v. (1899) pp. 102–4.

fluid. (2) The fluid is a modified Uschinsky's medium:—distilled water 1000 grm.; ammonium lactate 5 grm.; sodium asparaginate 2·5 grm.; sodium sulphate 2·5 grm.; sodium chloride 2·5 grm.; potassium phosphate (K_2HPO_4) 2·5 grm.; calcium chloride 0·1 grm.; magnesium sulphate 0·1 grm.

Instead of this fluid, Uschinsky's medium without the glycerin may be used, and instead of potato-starch, rice or any other kind of starch.

After thoroughly stirring up the starch in the fluid, the tubes are placed in a dry oven, where they are heated on 5 or 6 consecutive days for 2–3 hours at a temperature ranging from 75° to 85°. After the second heating it is advisable to put 2 ccm. of distilled water in each tube, to replace that lost by evaporation.

This medium keeps well, and is adapted for fungi and bacteria. It is especially suited for studying the diastatic action of bacteria.

To this starch-jelly, assimilable kinds of sugar may be added, and may be used for testing the nutrient value of various sugars, gums, or alcohol. Such substances must be added and dissolved before the starch. The author uses 500 mgrm. to each 10 cm. of fluid.

New Method for Cultivating Diphtheria Bacilli.*—Dr. A. Joos recommends his serum-agar as an infallible medium for the cultivation of diphtheria bacilli. It is prepared by mixing 800 ccm. of blood-serum with 50 ccm. of normal soda solution, and 150 ccm. of distilled water or bouillon. The mixture is placed in a flat-bottomed flask, and then heated for 2–3 hours in a water-bath at a temperature of 60°–70°. The temperature is then raised to 100°, or what is still better, the flask is placed for one-half to three-quarters of an hour in a steam steriliser. An equal quantity (500 ccm.) of peptonised bouillon and 20 grm. agar are now added. The solution is filtered while hot, sterilised for a quarter of an hour in an autoclave at 100°–110°, and then distributed into Petri's capsules. In making the foregoing, the only precaution necessary is not to raise the temperature too quickly, lest the albumen of the serum be coagulated.

The chief advantages claimed for this medium are that diphtheria bacilli invariably develop on it; streptococci never, and staphylococci scarcely at all. A diagnosis may be arrived at frequently in 5–6 hours, and always under 15 hours' incubation.

Cultivation of Leprosy Bacillus.†—Herr C. H. H. Spronck obtained from the tissues and bone-marrow of two cases of leprosy cultures on neutralised glycerin potato, which became visible after 10 days. The cultures contained rodlets which were longer and thicker than leprosy bacilli, and were more easily decolorised after staining in the usual way. The bacillus was also cultivated on Loeffler's serum and agar at 37°, but there was no growth at room temperature. Transfers from potato cultures were always unsuccessful.

Positive results were obtained with the serum reaction, the strength of which varied from 1 in 60 to 1 in 1000.

* Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 296–304, 351–7 (10 figs.).

† Weekblad v. h. Nederlandsch. Tijdschrift v. Geneeskunde, Deel ii. (1898) No. 14. See Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 257–8.

Medium for Bacteriological Examination of Water.*— Herren W. Hesse and Niedner give the following as the most suitable medium for water examination:—agar 1·25 per cent.; albumose (Herdgen) 0·75 per cent.; distilled water 98 per cent. This medium does not require correction for acid or alkali.

Protogen as Culture Medium.†—Herr J. Laboschin recommends protogen, on the grounds that most bacteria do better on it than on other albuminous media, and that it is more easily manipulated. The author at first made his own medium by beating up the whites of eggs with twice their bulk of water. Afterwards he used the Höchster protogen. Of the latter, 10 grm. were mixed with 3 grm. salt and 1000 ccm. of meat water. This produced a clear transparent medium.

(2) Preparing Objects.

Collecting and Preserving Diatoms.—The following hints on this subject are given by Dr. R. Lauterborn.‡ Among fixing reagents, Flemming's chromo-aceto-osmic acid, and sublimate in either water or alcohol solutions, demonstrate the most delicate structural features of the nucleus and cytoplasm during division. Picro-sulphuric acid, followed by a hæmatoxylin stain, gives excellent pictures of the chromatic elements of the nucleus. A 1 per cent. osmic acid solution serves, in unstained preparations, to bring out the arrangement of the cytoplasm, the chromatophores, and other inclusions of the cell. A 45 per cent. solution of iodic alcohol is recommended for the study of the so-called "red granules" of Bütschli. After remaining about 15 minutes in the fixing solution, the diatoms were passed, before staining, through alcohols of increasing strength up to absolute, and then through alcohols of decreasing strength to distilled water. The most useful stain is a weak solution of Delafield's hæmatoxylin; safranin is useful in demonstrating the centrosome and nucleoles. When stained, the specimens were passed successively through 35, 70, 95 per cent., and absolute alcohol into oil of cloves. It is possible to stain the diatoms to a certain extent during life in a very weak solution of methylen-blue (1 in 100,000), in which they live for days. For magnification, a Seibert apochromatic objective of 2 mm. focal length was usually employed, in combination with a No. 12 ocular, giving a magnification of about 1200.

Methods for Demonstrating Structure of Protoplasm.§ — In his paper on the structure of the protoplasm of human epidermal cells, Dr. Karl Herxheimer devotes a special section to technique. He hardened fragments of skin in 10 per cent. formol solution for 48 hours, washed in water, placed in 70 per cent. alcohol for 24 hours, and in absolute for the same time. They were then soaked in a mixture of alcohol and ether for 2·3 hours, imbedded in celloidin, and sectioned. Various stains were tried, of which the most novel was a basic anilin pigment—"cresylechtviolett," which was employed in concentrated

* Zeitschr. Hygiene, xxix. (1892) No. 3. See Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) p. 392.
† Inaug. Diss. Freiburg, 1898, 34 pp. See Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) p. 391. ‡ F. R. Rowley in 'Natural Science,' xiii. (1898) pp. 415–6.
§ Arch. f. Mikr. Anat., liii. (1899) pp. 510–46 (1 pl.).

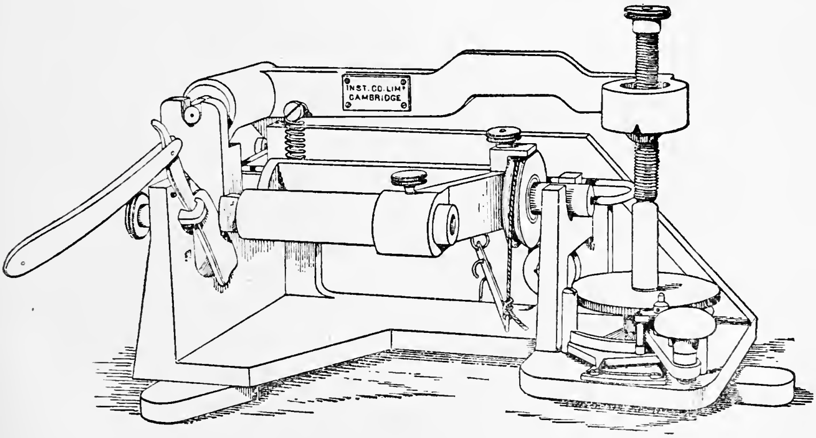
aqueous solution. It is very suitable for use after hardening in formol.

Microscopic Preparations of Copepoda.*—Copepoda are most easily collected, says Mr. C. D. Marsh, by means of a dredge, the mouth of which is covered with a cone of coarse wire gauze to keep out weeds, &c. For histological purposes, Copepoda are best killed by some one of the osmic acid preparations; for other purposes alcohol is the best reagent. The best staining results are obtained by immersion in dilute picrocarmine for 1–3 days. For dissecting Copepoda, it is advisable to place the animals on a slide and replace the alcohol by glycerin. Farrant's medium is recommended for mounting; the preparations can be transferred directly from the glycerin to the Farrant.

(3) Cutting, including Imbedding and Microtomes.

Rocking Microtome to cut Flat Sections.†—The Cambridge Scientific Instrument Company has produced a new pattern microtome to cut truly flat sections (fig. 91). It differs from the original rocking microtome in several respects. Larger sections can be cut, the tube holding the paraffin block being 30 mm. in internal diameter. The forward movement of the object towards the razor will allow of an object 12 mm. long being cut up without readjustment of the object-holder. A graduated

Fig. 91.

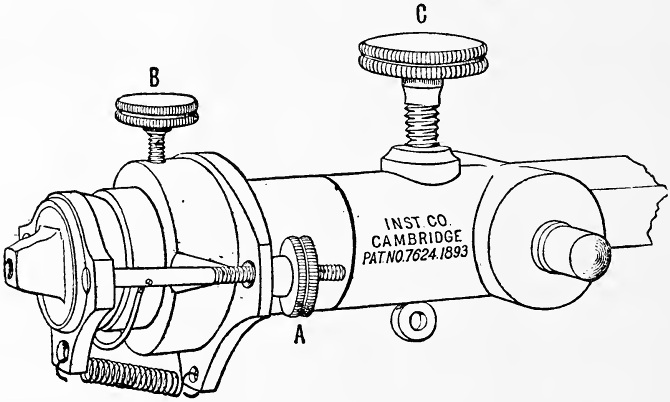


arc gives the thickness of the sections in thousandths of a millimetre. The object can be raised and fixed in a position clear of the razor, and the improved clamp is used for fixing the object-holder. The razor can be clamped either at right angles to the movement of the object or in a diagonal position for giving a slicing cut. The new instrument retains the essential features of the old rocking microtome,‡ but the arrangement is different, on account of the modification of the design.

* Journ. Applied Microscopy, ii. (1899) pp. 295–6.
† Cambridge Sci. Inst. Co.'s List, 1899, pp. 83–4 (1 fig.).
‡ Cf. this Journal, 1885, p. 549.

Improvements in the Cambridge Rocking Microtome.* — The Cambridge microtome has been improved by the addition of a new clamp and an adjustable object-holder (fig. 92). Either the simple tubular holder or the orientating apparatus is firmly clamped to the rocking arm by a small turn of a screw C. The advantages of this arrangement are that when the screw is loosened, the holder slides with perfect ease, giving an easy adjustment of the object towards the razor, and the connection of the rocking arm is very rigid. By means of the adjustable holder the object can be placed in the exact position for

Fig. 92.



cutting sections in the desired plane. The body of the holder consists of a tube of the same size as the ordinary tubular object-holder, and it is fixed to the rocking arm in the same manner. The object is placed in a hemispherical cup, which is firmly pressed against the open end of the tube by means of two screws, one of which is shown in the figure at A. When these screws are tightened up, the cup is turned about a vertical axis. If the head of the screw B is turned, the cup rotates about a horizontal axis. Thus the object can be rotated independently about a vertical or a horizontal axis.

(4) Staining and Injecting.

Simple Method for Staining Spores.†—The procedure recommended by Herr A. Klein is based on the observation that spores when in a moist condition are easily penetrated by pigments. A loopful of a 24 hours old culture of (say) anthrax is emulsified with two or three drops of salt solution in a watch-glass. To this emulsion is added a similar quantity of phenol-fuchsin recently filtered and freshly prepared, and the mixture thoroughly stirred. The watch-glass, covered with another, is heated over a burner to vaporisation for 6 minutes. After removal some of the fluid is dipped out and films made. These are

* Cambridge Sci. Inst. Co.'s List, 1899, p. 81 (1 fig.).
† Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 376–9.

allowed to dry in the air, and then fixed by passing twice through the flame. The next step is to decolorise in 1 per cent. sulphuric acid for 1–2 seconds. The films are now washed in water, after which they are contrast-stained in very dilute alcoholic solution of methylen-blue for 3–4 minutes. The preparations are then washed in water, dried, and mounted in balsam.

Staining Bacterial Spores.*—Dr. G. Catterina gives the following method for staining the spores of *B. anthracis*, &c. The spores are spread on cover-glasses, and fixed in the flame or in nitric acid fumes for 10–15 minutes. The preparations are then carefully washed with water, after which they are stained with Roux's fluid (methyl-green 1, 70 per cent. alcohol 10, water 90), heated to boiling. The addition of some more methyl-green imparts a better staining. The preparations are washed in water, and then stained with cold phenol-fuchsin solution. After this they are washed in water, 50 per cent. alcohol, and water again. The preparations are inspected in water.

Staining Bacteria in Tissues.†—Dr. C. Money states that the results from treating sections in the following manner are extremely good. The sections are first stained in picro-borax- or alum-carmine, and then in gentian-violet or methylen-blue to which 2–3 drops of formalin to a watchglassful of the solution have been added. The staining solution is then heated until it begins to vaporise. The excess of stain is washed off with water, and the preparations decolorised in 90 per cent. alcohol. It is advisable not to leave the preparations too long in formalin-gentian solution, because the decoloration becomes tedious.

Staining Plague Bacillus.‡—Dr. G. Boccardi gives the following as a good double stain for the plague bacillus in blood and pus preparations. Stain for 10 minutes in alcoholic or aqueous solution of eosin; wash in water, stain for one minute in weak methylen-blue solution (1–1000 water).

Staining the Granules in White Corpuscles.§ — Dr. G. Boccardi stains the granules in white corpuscles as follows. Fix the film for 5 minutes in osmic acid vapour. Immerse for a few seconds in peroxide of hydrogen diluted with five times the amount of water. Wash in water. Stain for 10–15 minutes in 1 per cent. aqueous solution of eosin, then for half a minute to a minute in methylen-blue solution. By this procedure the small neutrophile granules are stained red.

Method of Staining Mucous and other similar Cells.‖—The tissues, stomach, intestine, &c., says Dr. E. W. Carlier, should be fixed in sublimate or picro-sublimate, and after-hardened in alcohols of increasing strength. The sections should be washed in iodo-potassic iodide, and afterwards in water. The sections are stained on the slide in 0·5 per cent. aqueous solution of methylen-blue, patent B, for 10 minutes. The surplus stain having been washed off, the sections are treated with 0·6

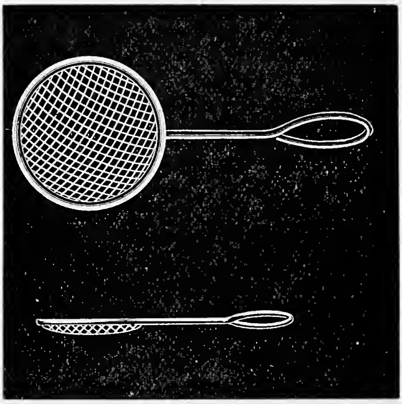
* Atti Soc. Veneto-Trentina, iii. (1898) p. 435.
† Centralbl. Bakt. u. Par., 1[te] Abt., xxv. (1899) p. 424.
‡ Riforma Med., 1897, No. 168. See Centralbl. Bakt. u. Par., 1[te] Abt., xxv (1899) p. 237.
§ Tom. cit., p. 237.
‖ Proc. Scot. Micr. Soc., ii. (1897–8) p. 212.

per cent. solution of potassium bichromate until they assume a violet colour. They are then washed in water, dehydrated in absolute alcohol, cleared in xylol, and mounted in balsam. By this method the mucigen granules are stained violet, and the rest of the cell blue.

The mucous cells of salivary glands are not stained by this method. The preparations fade very quickly, but the method is valuable for the study of mucigen granules.

Apparatus for Heating Staining Solutions.* — Dr. O. Korn describes with considerable amplitude an apparatus for holding a watch-

FIG. 93.



glass filled with staining solution over the flame. As the illustration shows (fig. 93), it much resembles a spoon, with a shallow wire-sieve bowl.

(6) Miscellaneous.

Simple Method for Detecting the Typhoid Bacillus.†—Herr Piorkowski states that by means of the following procedure a certain diagnosis of enteric fever can be made from the stools within 20 hours. Healthy urine, of sp. gr. 1020, is collected for 2–3 days, by which time it has acquired an alkaline reaction. The urine, mixed with 0·5 per cent. pepton and 3·3 per cent. gelatin, is boiled for an hour in a water-bath and then at once filtered, after which it is distributed into tubes. The tubes are plugged with cotton-wool, and steam sterilised at 100° for 15 minutes. The sterilisation is repeated next for 10 minutes. Three tubes are inoculated with typhoid fæces; the first with 2 loopfuls, the second with 4, and the third with 6–8. The plates are now laid, and when set must be kept at a temperature of 21°–22°.

By this procedure the yellowish-brown round colonies of *B. coli* and

* Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 422–3 (2 figs.).

† Tom. cit., p. 319.

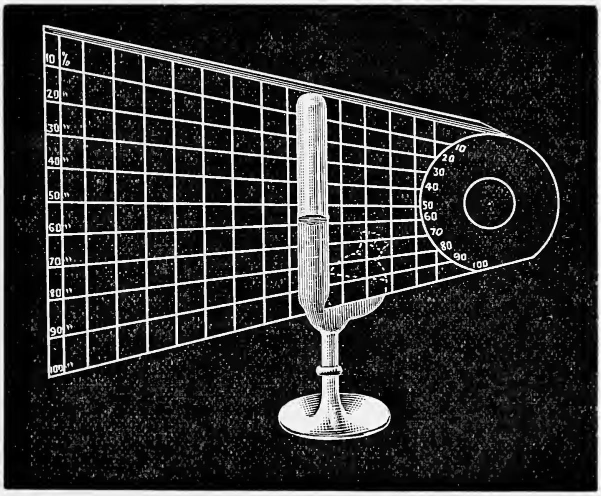
the small transparent colonies of the typhoid bacillus on the first plate are easily distinguishable in 20 hours under the Microscope. On the second plate, after 36 hours the typhoid colonies are yellowish, with markedly irregular margins, while the coli colonies are still round.

Keeping Mosquitoes alive.—Dr. Bancroft * has found that mosquitoes can be kept alive, after feeding once on human blood, by suspending a banana in the vessel in which the insects are confined. The banana should have the skin partially removed, and be renewed every fourth or fifth day. In this way the insects can be kept alive for upwards of six weeks. This fact may be useful to those experimenting with mosquitoes and blood parasites.

Mr. C. V. Creagh † states that he has kept mosquitoes alive and well by feeding them on a mixture of sherry and sugar. The mixture consisted of about a saltspoonful of dry sherry and an equal quantity of brown sugar, and was changed every 2 or 3 days. A small quantity of water should also be supplied. An inverted finger-glass, placed on coarse flannel to afford ventilation, forms a good cage.

Gasometer for Fermentation Tubes.‡ — The apparatus (fig. 94), devised by Mr. W. D. Frost, consists of a piece of triple-plated tin, cut in the shape indicated, about 8 in. long, 6 in. wide at one end, and 2 in.

Fig. 94.



at the other. About 1/2 in. of the upper edge is bent over at a right angle. The lines are ruled in with ink, and then the surface is brushed over with shellac. The perpendicular lines are about 1 cm. apart, and the nine radiating lines divide these into ten equal segments. The

* Brit. Med. Journ., 1899, i. p. 828. † Tom. cit., p. 1062.
‡ Journ. Applied Microscopy, ii. (1899) pp. 263–4 (1 fig.).

figures at each end indicate the percentage. The percentage volume is easily read off by resting the turned-over edge on the top of the closed arm of the tube, and moving the apparatus along until the lower edge rests on the neck connecting the arms. The apparatus, though chiefly intended for Dr. Th. Smith's fermentation tube, might be used for other similar apparatus.

Incubator for Maintaining Constant Low Temperatures.* — Dr. E. H. Wilson and Mr. R. B. F. Randolph have devised an apparatus for maintaining a constant low temperature (20° C.), adapted for work involving the use of gelatin and for storing stock-cultures and media.

The apparatus consists of an ordinary incubator enclosed in a wooden box. On the top of the box is an ice-tank, from which the ice-water is distributed in a uniform manner over the inner chamber. When the temperature gets too low, an electric regulator brings into action an electric stove; and when the temperature gets too high, another contact cuts off the heat. The regulators are so adjusted that the critical interval is quite short, allowing only a maximum variation of 0·5° C.

Detection of the Nectary in Flowers.†—Prof. P. Knuth finds that a very useful mode of determining the position of the nectary in flowers, i.e. of the exact spot where the excretion of sugar takes place, is to boil the entire organ either with Fehling's solution, or with Hoppe-Seyler's sugar reagent, ortho-nitro-phenol-propiolic acid; in the latter case a deep-blue deposition of indigo takes place in the presence of grape-sugar. He describes the localisation in this way of the nectary in a number of flowers.

Heavy Fluid suitable for Separating Mineral Mixtures.‡—For the fluids composed of iodine, mercury, cadmium, &c., which suffer from the common fault of being easily decomposed, Herr Muthmann has had the good fortune to obtain a good substitute in acetylen tetrabromide. It is a colourless compound which boils at 137° C., and possesses a specific gravity of 3·0011. The fluid is insoluble in water; it is soluble in ether, with which mixtures of any desired gravity can be prepared.

Antitoxic Action of Carmine.§—Dr. Stoudensky states that when powdered carmine is mixed with tetanotoxin, the action of the texin is suspended. The fluid used consisted of carmine in physiological salt solution and tetanotoxin. The antitoxic action is lost if the carmine solution be heated to 100°–120°, or if alkali be added.

If the carmine-toxin mixture be filtered, the filtrate contains no toxin. But though the carmine has fixed the toxin, the latter is not destroyed, for it may be extracted by maceration in distilled water. The antitoxic effect of the carmine is stated to be due to phagocytosis, as there is a smart reaction at the injection site. Here leucocytes accumulate and englobe the carmine particles, and along with these no doubt the toxin, which, though not chemically destroyed, is rendered inert.

* Brooklyn Med. Journ. See Micr. Bull., xvi. (1899) pp. 1–4 (2 figs.).

† Bot. Centralbl., lxxvi. (1898) pp. 76–83.

‡ Zeitschr. f. Krypt. (München), xxx. p. 73. See Zeitschr. f. ang. Mikr., iv. (1898) pp. 213–4.

§ Ann. Inst. Pasteur, xiii. (1899) pp. 126–8.

Carmine has a similar effect on diphtheria toxin. A carmine-diphtheria mixture containing ten fatal doses of toxin excites no intoxication.

Method of making Type Slides for Opaque Objects with Removable Covers.*—Mr. D. B. Scott describes this method of constructing a slide divided into 300 spaces of varying sizes. For the details of the procedure the original should be consulted.

* Journ. Quekett Micr. Club, vii. (1899) pp. 167–70 (2 figs.).

PROCEEDINGS OF THE SOCIETY.

Meeting of the 19th of April, 1899, at 20 Hanover Square, W.
The President (E. M. Nelson, Esq.) in the Chair.

The Minutes of the Meeting of the 15th of March last were read and confirmed, and were signed by the President.

The List of Donations to the Society—exclusive of exchanges and reprints—received since the last Meeting was read, and the thanks of the Meeting were voted to the Donors.

	From
Braithwaite, R., British Moss Flora, Pt. xix. (4to, London, 1899)	*The Author.*
Bulletin de la Société des Sciences de Bucarest. (4to, Bucarest, 1898)	*The Society.*
Journal of the Board of Agriculture, Vol. v. No. 4. (8vo, London, 1899)	*The Board of Agriculture.*
An Old Microscope	*Dr. W. H. Dallinger.*
An Old Microscope by Adams	*Mr. J. M. Offord.*

Special attention was called to two old Microscopes which had been presented to the Society.

The first was an Adams, which was sent last month by Mr. J. M. Offord; and the second, which might possibly be a Benjamin Martin, Dr. Dallinger had asked the President to present in his name to-night.

They were then described by the President (see p. 324), and the thanks of the Society were unanimously voted to the donors of these interesting Microscopes.

Dr. Hebb called attention to two slides sent for exhibition by Miss V. A. Latham, M.D., F.R.M.S. The preparations showed the difference between the reaction of normal and diabetic blood to methylen-blue. While normal blood stains well, the blood-film of diabetes is but feebly coloured, and thus an easy clinical test for diabetes is established.

The reaction possibly depends on the reducing power of glucose, for glucose rapidly decolorises methylen-blue. In order to show this, it is only necessary to boil an alkaline solution of methylen-blue and add a piece of glucose. The colour almost instantly fades away, but is restored if the tube be shaken so as to aerate the solution.

The President regretted to say that they had that morning heard that Dr. Lionel Beale had been taken ill for about the first time in his life, and was therefore unable to come and read the paper which they had hoped to hear from him that evening.

Dr. Hebb said a letter had been received from Mr. D. Bryce Scott, in which he remarked that he had seen Mr. Durrand's paper on the Foraminifera of the Malay Archipelago, and said that if any Fellow of the Society was interested in the subject and would like to have some West India dredgings, he should be very pleased to supply them.

The President said that when the Fellows of the Society received their copies of the Journal for April, they would find, as a frontispiece, a very excellent portrait of the late Mr. Hugh Powell. He was well known to the Society, and would be remembered by many of the Fellows. He also had great pleasure, on behalf of the Society, in asking Mr. Thomas Powell's acceptance of a framed proof copy of this portrait of his father.

Mr. Thomas Powell expressed his sincere thanks to the Society for the gift.

Dr. Hebb said he had been asked to mention that the Ray Society was in want of an additional number of members at the present time. If any of the Fellows present were inclined to support this Society, it would be conferring a great benefit upon science generally.

The President said that as they had been disappointed in not hearing Dr. Beale's paper, and there being nothing else to bring before the Meeting, he would make a few remarks upon the theory and construction of eye-pieces for the Microscope; in the course of which he described a new eye-piece of his own invention, which he now introduced for the first time to the notice of the Fellows. He then proceeded to explain the subject by means of diagrams upon the board.

Mr. Sebastian Davis said there seemed to be a great diversity of opinion as to whether or not it was better to use an eye-piece in taking photomicrographs of low-power objects; and he wished to ask the President if he considered that this new form of eye-piece of which they had just heard the description would be of any use in delineating objects on a space of 3 inches square.

The President thought that for projection purposes it was generally better to use an eye-piece rather than none, except for quite low-powers such as the new Planar. He had not tried the new form of eye-piece in this way, but he did not think it would be of much service for this purpose.

Canon Carr inquired if a compensating eye-piece would be of any use for this purpose.

The President said that in the compensating eye-piece they had an over-corrected combination to meet the under-correction of apochromatic object-glasses; when he tried apochromatic objectives with a common Huyghenian eye-piece he found they did not give so good an image.

The President proposed that a very hearty vote of thanks be given to Messrs. Beck, Powell, and Curties, for kindly cleaning the old object-glasses in the Society's Cabinet—all of which were in consequence now in first-rate condition.

This proposition was carried by the Meeting with acclamation.

It was announced that at the next Meeting it was hoped Dr. H. C. Sorby would read a paper on the Preparation of Microscopical Specimens of Marine Worms.

The following Instruments, Objects, &c., were exhibited:—

The Society:—Two old Microscopes.

Dr. Hebb, for Miss V. A. Latham, M.D. F.R.M.S.:—Two Slides, showing the difference between the reaction of Normal and Diabetic Blood to Methylen-blue.

New Fellows:—The following were elected *Ordinary* Fellows:—Messrs. Peyton T. B. Beale, J. Bliss, Mrs. Mary A. D. Jones, and Mr. Walter Jas. Wood.

MEETING

Held on the 17th of May, 1899, at 20 Hanover Square, W., The President (E. M. Nelson, Esq.) in the Chair.

The Minutes of the Meeting of 19th April last were read and confirmed, and were signed by the President.

The List of Donations to the Society, exclusive of exchanges and reprints, received since the last Meeting, was submitted.

	From
Trinchese, S., Æolididæ e Famiglie Affini del porto di Genova. (4to, part 1, Bologna, 1877–78–79; part 2, Rome, 1881) ..	*Mr. F. W. Mills.*
Photographs, by Mr. Jas. Wedeles, of Rulings on Glass by Mr. H. J. Grayson, and of Slides of Diatoms	*Mr. Jas. Wedeles.*

Dr. Hebb called special attention to the two very beautiful volumes presented to the Society by Mr. F. W. Mills, which would be a very useful and valuable addition to the library.

The thanks of the Society were voted to the donors; a special vote of thanks being, on the motion of the President, accorded to Mr. Mills.

Mr. C. L. Curties exhibited and described a new electrically heated stage recently brought out by Reichert of Vienna, constructed so as to be heated by the current from the ordinary electric-lighting supply, to which it could be readily attached by a flexible cord. A thermometer on the stage enabled the operator to see the temperature attained, which by an ingenious arrangement could be regulated to any required degree. This was accomplished by means of a small separate battery and contact breaker, which came into action as soon as the prescribed limit was exceeded, and, by interrupting the main circuit, cut off the current from the stage until it had cooled down to the temperature for which the thermometric regulator had been set. It was claimed that this automatic action could be relied upon to maintain the heat of the stage constant to within 0·1° C.

The President said that the thanks of the Society were due to Mr. Curties for bringing this very ingenious apparatus to show them.

W. Watson & Sons exhibited a table-stage designed by Mr. G. T. West, for use in conjunction with any Microscope when working with fluids or making dissections; its special object being to avoid the damaging of the stage of the Microscope when doing the rough work. It was constructed of metal, in the shape of half an octagon. The vertical sides rested upon the table, the horizontal surface covered the stage of the Microscope completely, and the sloping surfaces, which were covered with mahogany, afforded support for the hands. The chief advantage of this arrangement was, that the ordinary Microscope-tube with its adjustments, eye-pieces, and objectives, could be worked upon this stage as conveniently as upon the ordinary fixed stage, a central aperture being cut for illuminating with the mirror from below. For dissecting, a glass plate would be placed upon the upper surface, which, being of metal, could be heated and used as a warm stage or for mounting purposes.

The President thought that, what at first sight looked like the adaptation of a beetle-trap to the Microscope, was a very practical and ingenious contrivance, and admirably adapted to the purpose for which it was intended. It would no doubt be found of great service for laboratory use.

The President called the attention of the Fellows to some very beautiful photographs of Mr. Grayson's rulings, taken by Mr. Wedeles, a Fellow of this Society, which he had presented to the Society. Both the rulings and the photographs were very remarkable productions, and well worth careful study by the Fellows. He thought that they were the finest productions of the kind he had ever seen.

The thanks of the Meeting were voted to Mr. Curties and Messrs. Watson for their exhibits, and also to Mr. Grayson for the photographs.

The expected communication from Dr. Sorby not being forthcoming, and there being nothing else upon the Agenda, the President read a paper upon the History of the Fine Adjustment, in which he described the various forms which had been adopted from time to time, and said that in the course of his investigations he had been able to correct some prevalent errors as to priority of invention, and had conclusively discovered that in connection with this matter Varley had been very unjustly treated, inasmuch as his inventions had been ascribed to others; and also that the long lever-adjustment generally ascribed to Ross was really first made by Powell.

The President then called attention to the exhibition of "Pond Life" under the Microscopes upon the tables, and thanked those Members of the Quekett Club and Fellows of the Society who had contributed to this exhibition.

The thanks of the Society were also given to Messrs. Watson and Sons for the Microscopes which had been lent for the occasion.

The Meeting then resolved itself into a Conversazione, at which the following Instruments, Objects, &c. were exhibited:—

Chas. L. Curties (C. Baker):—An electrically heated Hot-stage for the Microscope.

W. Watson and Sons:—A Dissecting Stage applicable to an ordinary Microscope.

Mr. A. W. Bird:—*Lophopus crystallinus.*

Mr. G. P. Dineen:—*Daphnia pulex* stained with a solution of fuchsin.

Mr. A. Earland:—*Hydatina senta.*

Mr. Ersser:—*Melicerta ringens.*

Mr. G. T. Harris:—*Hydra viridis*, showing ovary and testes, the ovary in the amœboid stage.

Mr. J. T. Holder:—*Melicerta ringens.*

Mr. John Hood:—*Bursaria truncatella*, *Conochilus volvox*, *Stephanoceros Eichhorni*, *Volvox globator.*

Mr. H. Lloyd:—*Daphnia pulex.*

Mr. Macer:—*Cristatella mucedo.*

Mr. Mainland:—*Draparnaldia plumosa*, and *Rivularia* sp.

Dr. Measures:—*Stephanoceros Eichhorni.*

Mr. Muiron:—Various Rotifers.

Mr. Rousselet:—*Fredericella sultana*, *Asplanchna priodonta*, *Brachionus pala*, *Limnias annulatus. L. cornuella*, *Mastigocerca bicarinata*, *M. lophoessa*, and *Synchæta pectinata*, mounted.

Mr. Scourfield:—*Simocephalus serrulatus* (previously unrecorded in Great Britain).

Mr. Sidwell:—*Simocephalus serrulatus.*

Mr. Soar:—*Hydrophantes dispar.*

Mr. Taverner:—*Limnesia histrionica.*

Mr. Traviss:—*Notops brachionus.*

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

AUGUST 1899.

TRANSACTIONS OF THE SOCIETY.

VII.—*Report on the Recent Foraminifera of the Malay Archipelago, collected by Mr. A. Durrand, F.R.M.S.—Part V.*

By Fortescue William Millett, F.R.M.S.

(*Read 15th March*, 1899.)

Plate V.

Haplophragmium Reuss.

Haplophragmium agglutinans d'Orbigny sp., plate V. fig. 1.

Spirolina agglutinans d'Orbigny, 1846, For. Foss. Vienne, p. 137, pl. vii. figs. 10–12. *Haplophragmium agglutinans* (d'Orb.) Brady, 1884, Chall. Rept., p. 301, pl. xxxii. figs. 19–26. *H. agglutinans* (d'Orb.) Haeusler, 1885, Neues Jahrb. für Min., Beil. Bd. iv. p. 13, pl. i. figs. 22, 23, and pl. ii. figs. 3, 4. *H. agglutinans* (d'Orb.) Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. p. 330, pl. xiii. figs. 18–20. *H. agglutinans* (d'Orb.) Sherborn and Chapman, 1889, Journ. R. Micr. Soc., p. 484, pl. xi. fig. 8. *H. agglutinans* (d'Orb.) Haeusler, 1890, Abhandl. schweiz. pal. Gesell., vol. xvii. p. 32, pl. iii. figs. 32, 36, and pl. iv. figs. 5, 6, 18. *H. agglutinans* (d'Orb.) Fornasini, 1891, Foraminiferi Pliocenici del Ponticello di Savena, pl. ii. fig. 5. *H. agglutinans* (d'Orb.) Chapman, 1892, Journ. R. Micr. Soc., p. 324, pl. v. fig. 14. *H. agglutinans* (d'Orb.)

EXPLANATION OF PLATE V.

Fig. 1.—*Haplophragmium agglutinans* d'Orbigny sp. × 90.
„ 2, 3. „ „ var. *triperforata* var. n. × 90.
„ 4–6. „ *cassis* Parker sp. × 90.
„ 7. „ „ or ? *Reophax.* × 60.
„ 8. „ *compressum* Goës. × 60.
„ 9. „ *nanum* Brady. × 90.
„ 10. „ *anceps* Brady. × 90.
„ 11.—*Placopsilina bulla* Brady. × 45.
„ 12.—*Trochammina ochracea* Williamson sp. × 60.
„ 13. „ *plicata* Terquem sp. × 135.
„ 14. „ *ringens* Brady. × 90.

Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 260, pl. iv. figs. 16, 36. *H. agglutinans* Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 23, pl. v. figs. 140, 141. *H. agglutinans* (d'Orb.) Chapman, 1895, Ann. and Mag. Nat. Hist., ser. vi. vol. xvi. p. 313, pl. xi. fig. 2.

The specimens are all minute, and although they occur at most of the Stations, are not very numerous.

Haplophragmium agglutinans var. *triperforata* var. n., plate V. figs. 2, 3.

Having the general form of the type, this varies in two respects; the shell wall, instead of being rough through the coarseness of the incorporated sand-grains, is smooth as in the genus *Trochammina*; this smoothness however does not arise from an excess of cement, but from the fineness of the material employed. In place of the simple aperture there are always three perforations with raised borders, arranged in the form of a triangle. As shown by fig. 3, these perforations exist in the spiral as well as in the uniserial chambers. The interior is quite smooth and not at all labyrinthic; hence its affinities seem to be with *Haplophragmium* rather than with *Lituola*. It is not uncommon at Station 9, and occurs also, but very sparingly, at Station 5.

Its nearest ally appears to be the *H. lituolinoideum* of Goës from the Gulf of Mexico.*

Haplophragmium pseudospirale Williamson sp.

Proteonina pseudospiralis Williamson, 1858, Rec. Foram. Gt. Britain, p. 2, pl. i. figs. 2, 3. *Haplophragmium pseudospirale* (Will.) Siddall, 1879, Catal. Brit. Rec. Foram., p. 4. *H. pseudospirale* (Will.) Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. p. 330, pl. xiii. figs. 6–8. *H. pseudospirale* (Will.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II, vol. xviii. p. 260, pl. v. figs. 41, 42. *H. pseudospiralis* (Will.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 23, pl. v. figs. 142–151. *H. pseudospirale* (Will.) de Amicis, 1895, Naturalista Siciliano, Anno xiv. p. 9, pl. i. fig. 11.

The typical form with obscure segmentation is rare, but at several of the Stations there are numerous examples which have the sutures well marked, and which differ from *H. agglutinans* only in the compression of the test. Of the figures by Goës referred to above, 148 and 149 represent this form.

In the 'Challenger' Report the only localities given by Brady for this species are about the coasts of the British Isles; but in the 'Summary of the Scientific Results' it is reported from Station 172A (Tongatabu). The Gazelle Station is off West Australia.

* Bull. Mus. Comp. Zool. Harvard Coll., vol. xxix. 1896, p. 32, pl. iii. figs. 17–20.

Haplophragmium cassis Parker sp., plate V. figs. 4–6 and ? 7.

Lituola cassis Parker, 1870, Canadian Naturalist n.s., vol. v. p. 177, fig. 3. *Haplophragmium cassis* (Parker) Brady, 1884, Chall. Rept., p. 304, pl. xxxiii. figs. 17–19. *H. cassis* (Parker) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II, vol. xviii. p. 261, pl. v. figs. 55, 56. *H. cassis* (Parker) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 24, pl. v. figs. 152–157.

The Malay specimens of this species are very variable in form, some of them being extremely compressed, and composed of numerous chambers.

Fig. 3 represents one of numerous fragments which have precisely the shell structure of *H. cassis*, and may be the final chambers of an abnormal form. An inclination to this rectilinear arrangement of the chambers is observable in fig. 4. On the other hand, it may be a species of *Reophax*, with the plan of growth and chevron-shaped chambers of a *Frondicularia*.

This and the typical form occur only at Station 9, where they are not uncommon.

The species is not represented in the 'Challenger' dredgings. Egger's specimens were procured from the West Coast of Africa, near the equator.

Haplophragmium compressum Goës, pl. V. fig. 8.

Lituolina irregularis var. *compressa* Goës, 1882, K. Svenska Vet.-Akad. Handl., vol. xix. p. 141, pl. xii. figs. 421–423. *Haplophragmium emaciatum* Brady, 1884, Chall. Rept., p. 305, pl. xxxiii. figs. 26–28. *H. emaciatum* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II, vol. xviii. p. 262, pl. v. figs. 53, 54. *H. emaciatum* (Brady) Chapman, 1895, Ann. and Mag. Nat. Hist., ser. vi. vol. xvi. p. 315, pl. xi. fig. 6. *H. compressum* (Goës) Goës, 1896, Bull. Mus. Comp. Zool. Harvard College, vol. xxix. p. 31.

There can be but little doubt that Goës is correct in associating Brady's *H. emaciatum* with his own previously described *H. compressum*, and he is probably right in considering the form a variety of the *H. fontinense* of Terquem.

The Malay specimens are unusually robust and well developed, but their range is very limited.

Haplophragmium canariense d'Orbigny sp.

Nonionina canariensis d'Orbigny, 1839, Foram. Canaries, p. 128, pl. ii. figs. 33, 34. *Haplophragmium canariense* (d'Orb.) Siddall, 1879, Catal. Rec. Brit. Foram., p. 4. *Nonionina* (*Lituola*) *canariensis* (d'Orb.) or *N. Jeffreysi* (Will.) Schlumberger, 1882, Feuille des Jeunes Naturalistes, Ann. xii. p. 39, pl. ii. figs. 6, 7. *H. canariense* (d'Orb.) Haeusler, 1885, Neues Jahrb. für Min., Beil. Bd. iv. p. 12, pl. i. figs. 17–20. Idem, 1890, Abhandl. schweiz. pal. Gesell., vol. xvii.

p. 34, pl. iv. figs. 1–3. *H. canariense* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II, vol. xviii. p. 261, pl. v. figs. 27–29. *H. canariense* (d'Orb.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 20, pl. v. figs. 95–101. *H. canariense* (d'Orb.) Chapman, 1895, Ann. and Mag. Nat. Hist., ser. vi. vol. xvi. p. 314, pl. xi. fig. 5.

The examination of any considerable number of examples of this species will show that there is always going on a struggle to deviate from the nautiloid form and to become evolute, at the same time becoming more compressed and more or less acute at the margin, finally merging into such forms as *H. compressum* and *H. fontinense*.

The Malay specimens have the usual range of variation; they are very numerous, and are restricted almost entirely to Area 1.

Haplophragmium latidorsatum Bornemann sp.

Nonionina latidorsata Bornemann, 1855, Zeitschr. deutsch. geol. Gesell., vol. vii. p. 339, pl. xvi. fig. 4. *Lituolina irregularis* (Röm.) Goës, 1882, K. Svenska Vet.-Akad. Handl., vol. xix. p. 139, pl. xii. figs. 419, 420. *Haplophragmium latidorsatum* (Born.) Brady, 1884, Chall. Rept, p. 307, pl. xxxiv. figs. 7–10, 14. *H. latidorsatum* (Born.) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xiv. p. 218, pl. xli. figs. 14, 22. *H. latidorsatum* (Born.) Haeusler, 1890, Abhandl. schweiz. pal. Gesell., vol. xvii. p. 35, pl. iii. figs. 37, 38. *H. latidorsatum* (Born.) Chapman, 1892, Journ. R. Micr. Soc., p. 323, pl. v. fig. 12. *H. latidorsatum* (Born.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 21, pl. v. figs. 102–120.

In all the specimens the shell structure is coarse and the aperture simple. Its range in the Malay Archipelago is very restricted, although where it occurs the individuals are numerous.

According to Brady it is one of the commonest deep-water species of arenaceous foraminifera. Goës records it from the Pacific and from the Caribbean Sea.

Haplophragmium nanum Brady, plate V. fig. 9.

H. nanum Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s. p. 50. Idem, 1881, Ann. and Mag. Nat. Hist., ser. v. vol. viii. p. 406, pl. xxi. fig. 1. *H. nanum* (Brady) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xiv. p. 218, pl. xli. fig. 20. *H. nanum* (Brady) Chapman, 1892, Journ. R. Micr. Soc., p. 324, pl. v. fig. 15. *H. nanum* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II, vol. xviii. p. 262, pl. v. figs. 13–15. *H. nanum* (Brady) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 22, pl. v. figs. 124–127.

The specimens are all characteristic, with little or no tendency to variation. It is most abundant in Area 1.

The 'Gazelle' Stations are West Africa, Mauritius, and New

Guinea. Goës reports it from the North Atlantic and from the Arctic regions.

Haplophragmium globigeriniforme Parker and Jones

(?) *Globigerina bulloides* (d'Orb.) Williamson, 1858, Rec. Foram. Gt. Britain, p. 56, pl. v. figs. 116–118. *Lituola nautiloidea* var. *globigeriniformis* Parker and Jones, 1865, Phil. Trans., vol. clv. p. 407, pl. xv. figs. 46, 47, and pl. xvii. figs. 96–98. *H. globigeriniforme* (P. & J.) Siddall, 1879, Catal. Brit. Rec. For., p. 64. *H. globigeriniforme* (P. & J.) Balkwill and Millett, 1884, Journ. Microscopy and Nat. Sci., vol. iii. p. 25, pl. i. fig. 5. *H. globigeriniforme* (P. & J.) Haeusler, 1890, Abhandl. schweiz. pal. Gesell., vol. xvii. p. 36, pl. iv. figs. 13, 16, 17. *H. globigeriniforme* (P. & J.) Terrigi, 1891, Mem. R. Com. Geol. d'Italia, vol. iv. p. 68, pl. i. fig. 7. *H. globigeriniforme* (P. & J.) Chapman, 1892, Journ. R. Micr. Soc., p. 324, pl. v. fig. 16. *H. globigeriniforme* (P. & J.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II, vol. xviii. p. 260, pl. v. figs. 30, 31. *H. globigeriniforme* (P. & J.) Goes, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 22, pl. v. figs. 128–133.

Williamson's description of *Globigerina bulloides* is "Texture arenaceous, granular. Hue yellowish grey." This is correct for the present species, but not for *G. bulloides*; and according to the rules of nomenclature the species should be described as *H. bulloides* Williamson sp.; but sometimes the rule is more honoured in the breach than in the observance, and it may be excusable in the present instance to assume that Williamson had wrongly diagnosed the texture of the test.

It is abundant at a few of the Stations in both Areas, but the specimens are very small.

Haplophragmium anceps Brady, plate V. fig. 10.

H. anceps Brady, 1884, Chall. Rept., p. 313, pl. xxxv. figs. 12–15. *H. anceps* (Brady) Chaster, 1892, First Rept. Southport Soc. Nat. Sci., 1890–91, p. 57, pl. i. fig. 2.

The specimens are numerous and well distributed; although very small they are quite characteristic and, as may be inferred from Brady's remarks, resemble both *H. globigeriniforme* and *Verneuilina propinqua*.

It is one of the exceedingly interesting forms added to the list of the British Foraminifera by Dr. Chaster.

Placopsilina d'Orbigny.

Placopsilina bulla Brady, plate V. fig. 11.

P. bulla Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s., p. 51. Idem, 1884, Chall. Rept., p. 315, pl. xxxv. figs. 16, 17.

P. bulla (Brady) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 28, pl. vi. figs. 211–215. *P. bulla* (Brady) Grzybowski, 1894, Rozpraw Wydz. mat. przyr. Akad. Umiej. Krakowie, vol. xxix. p. 186, pl. i. fig. 1. *P. bulla* (Brady) Goēs (1894) K. Svenska Vet.-Akad. Handl., vol. xxv. p. 28, pl. v. figs. 211–215.

The solitary specimen, from Station 14, differs from the usual form in having the test composed of fragments of considerable size from various organisms, giving it the rough appearance shown in the figure. In other respects it is sufficiently characteristic, and has an aperture at each end. Some of the specimens figured by Goës indicate a relationship with *P. vesicularis*; they are from the Skagerack and Koster Island.

Sub-Family **Trochammininæ.**

Ammodiscus Reuss.

Ammodiscus incertus d'Orbigny sp.

Operculina incerta d'Orbigny, 1839, Foram. Cuba, p. 49, pl. vi. figs. 16, 17. *Ammodiscus incertus* (d'Orb.) Berthelin, 1878, Foram. Bourgneuf et Pornichet, p. 25. *Trochammina incerta* (d'Orb.) Deecke, 1886, Mém. Soc. Emul. Montbéliard, sér. iii. vol. xvi. p. (14), pl. i. fig. 9. *A. incertus* (d'Orb.) Mariani, 1889, Boll. Soc. Geol. Ital., vol. vii. p. 284, pl. x. fig. 1. *A. incertus* Sherborn and Chapman, 1889, Journ. R. Micr. Soc., p. 484, pl. xi. fig. 7. *A. incertus* (d'Orb.) Burrows, Sherborn, and Bailey, 1890, Journ. R. Micr. Soc., p. 552, pl. viii. fig. 8. *A. incertus* var. *gracilis* (Kübler and Zwingli) Wisniowski, 1890, Pamiet. Wydz. III, Ak. Umiej. Krakowie, vol. xvii. p. 10, pl. viii. fig. 11. *A. incertus* (d'Orb.) Haeusler, 1890, Abhandl. schweiz. pal. Gesell., vol. xvii. p. 55, pl. ix. figs. 1–21. *A. incertus* (d'Orb.) Crick and Sherborn, 1891, Journ. Northampton Nat. Hist. Soc., vol. vi. p. 209, pl. fig. 1. *A. incertus* (d'Orb.) Chapman, 1892, Journ. R. Micr. Soc., p. 326, pl. vi. fig. 11. (?) *A. infimus* (Strickland) Sellheim, 1893, Inaug. Diss. Friedr. Alex. Univ., p. 9, pl. fig. 1. *A. incertus* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II, vol. xviii. p. 263, pl. v. figs. 35, 36. *A. incertus* (d'Orb.) Goës, 1895, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 31, pl. vi. figs. 238, 239. *A. incertus* (d'Orb.) Chapman, 1895, Ann. and Mag. Nat. Hist., ser. vi. vol. xvi. p. 315, pl. xi. figs. 8, 9.

Specimens are small, ill-developed, and not numerous; it occurs however in both Areas.

Although found at many 'Challenger' Stations, only one of them was in the North Pacific. The sole 'Gazelle' Station is West Australia.

Trochammina Parker and Jones.

Trochammina squamata Jones and Parker.

T. squamata Jones and Parker, 1860, Quart. Journ. Geol. Soc., vol. xvi. p. 304. *T. squamata* (P. & J.) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 407, pl. xv. fig. 30. *T. squamata* (P. & J.) Haeusler, 1885, Neues Jahrb. für Min., Beil. Bd. iv. p. 29, pl. iii. fig. 30. Idem, 1890, Abhandl. schweiz. pal. Gesell., vol. xvii. p. 65, pl. x. figs. 27–29, 40. *T. squamata* (P. & J.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II, vol. xviii. p. 264, pl. v. figs. 4–6.

What may be called the inflated form of the species is the commonest of all the arenaceous foraminifera in the Malay Archipelago, and it occurs at most of the Stations. The specimens are small, but characteristic.

The 'Gazelle' Stations are Kerguelen and Mauritius.

Trochammina ochracea Williamson sp., plate V. fig. 12.

Rotalina ochracea Williamson, 1858, Rec. Foram. Gt. Britain, p. 55, pl. iv. fig. 112, and pl. v. fig. 113. *Trochammina squamata* (P. & J.) Parker and Jones, 1865, Phil. Trans., vol. clv. p. 407, pl. xv. fig. 31. *T. ochracea* (Williamson) Balkwill and Millett, 1884, Journ. Microscopy and Nat. Sci., vol. iii. p. 25, pl. i. fig. 7.

This form is very rare, and has been observed only at Station 3.

Hitherto it has been recorded only from the British Isles, from the Arctic Regions (Parker and Jones), and from the Channel Islands (Halkyard).

Trochammina plicata Terquem sp., plate V. fig. 13.

Patellina plicata Terquem, 1876, Anim. Plage de Dunkerque, 2me fasc., p. 72, pl. viii. fig. 9. *Trochammina plicata* (Terq.), Balkwill and Millett, 1884, Journ. Microscopy and Nat. Sci., vol. iii. p. 26, pl. i. fig. 8. *T. plicata* (Terq.) Halkyard, 1889, Trans. and Ann. Nat. Rept. Manchester Micr. Soc., p. (10) pl. i. fig. 11.

This delicate scale-like form occurs only at Station 25, and is there, as elsewhere, extremely rare.

Its general distribution is the same as that of *T. ochracea.*

Trochammina nitida Brady.

T. nitida Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. n.s., p. 52. *T. nitida* Brady, 1884, Chall. Rept., p. 339, pl. xli. figs. 5, 6. *T. nitida* (Brady) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 30, pl. vi. figs. 225–230.

At Station 6 there are some fine typical examples of this rare form; but elsewhere, although the characteristic flatness of the superior face is apparent, there are fewer chambers in the convolutions, and the relationship with *T. inflata* is in many instances well marked. Goës, who reports it from Spitzbergen, describes it as an emaciated form of *T. inflata,* and gives the number of segments in the last convolution as 6–9. In the majority of the Malay specimens the number of segments to the convolution is six; the colour is always grey.

It is found in its restricted form, rather abundantly at a few Stations, mostly in Area 1.

Trochammina inflata Montagu sp.

Nautilus inflatus Montagu, 1808, Testac. Brit., Supplement, p. 81, pl. xviii. fig. 3. *Trochammina inflata* (Mont.) Carpenter, Parker, and Jones, 1862, Introd. Foram., p. 141, pl. xi. fig. 5. *T. inflata* (Mont.) Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. p. 331, pl. xiii. figs. 11, 12. *T. inflata* (Mont.) Haeusler, 1890, Abhandl. schweiz. pal. Gesell., vol. xvii. p. 65, pl. x. figs. 25, 26. *T. inflata* (Mont.) Woodward and Thomas, 1893, Geol. and Nat. Hist. Survey of Minnesota, vol. iii. p. 28, pl. D, fig. 31. *T. inflata* (Mont.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II, vol. xviii. pl. v. figs. 10–12, 16–18. *T. inflata* (Mont.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 29, pl. vi. figs. 222–224.

In abundance this species almost equals *T. squamata*, and is rather more widely distributed. The specimens, as usual, have the primary chambers of a dark colour.

There are but few records of the occurrence of this species outside the British Isles. Brady gives no 'Challenger' Stations, but in the 'Summary of the Scientific Results' it is reported from Stations 237 and 323. Berthelin reports it from Belgium, Cherbourg, and from Bourgneuf and other places in the Bay of Biscay. Robertson procured it from the coast of Spain, and Goës from the Baltic. The 'Gazelle' stations from which it was obtained are not named.

Trochammina inflata var. *macrescens* Brady.

T. inflata var. *macrescens* Brady, 1870, Ann. and Mag. Nat. Hist., ser. iv. vol. vi. p. 290, pl. xi. fig. 5.

This variety differs from the type not only in the indentation of the chambers, but also in its tendency to the nautiloid form of growth.

It occurs sparingly at a few Stations in the Malay Archipelago.

Trochammina trullissata Brady.

T. trullissata Brady, 1879, Quart. Journ. Micr. Sci., vol. xix. p. 56, pl. v. figs. 10, 11. *T. trullissata* (Brady) Haeusler, 1890, Abhandl. schweiz. pal. Gesell., vol. xvii. p. 64, pl. x. figs. 9, 11. *T. trullissata* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II, vol. xviii. p. 265, pl. v. figs. 25, 26.

This species is very abundant, and occurs at several Stations in both Areas. The punctation or reticulation of the interior surface is not apparent.

In the 'Gazelle' examples, which are from West Africa and West Australia, the aperture is porous. Goës reports it from the Pacific and the Caribbean Sea.

Trochammina ringens Brady, plate V. fig. 14.

T. ringens Brady, 1879, Quart. Journ. Micr. Sci., vol. xix. p. 57, pl. v. fig. 12.

Of this very rare deep-water form there are a few specimens from both Areas. They are characteristic, and are easily distinguishable from *T. trullissata.*

Brady says of this species, "Its area of distribution does not appear to extend beyond the Atlantic." Goës reports it from both sides of the Isthmus of Panama.

Carterina spiculotesta Carter sp.

Rotalia spiculotesta Carter, 1877, Ann. and Mag. Nat. Hist., ser. iv. vol. xx. p. 470, pl. xvi. figs. 1–3. *Carterina spiculotesta* (Carter) Brady, 1884, Chall. Rept., p. 346, pl. xli. figs. 7–10.

Of this interesting form there is but one specimen, and that is from Station 28. It is very regular in form, and, as in *Trochammina inflata,* the primary chambers are of a dark colour.

VIII.—*On the Evolution of the Fine Adjustment.*

By Edward M. Nelson, Pres. R.M.S.

(*Read 17th May*, 1899.)

As there was no paper available for this evening, the occasion seemed suitable for supplementing my former paper on the coarse adjustment * by a dissertation on the fine adjustment. There will, however, be this difference between the papers, viz. that in the former I had a new kind of coarse adjustment to bring before you, while in this I have no fresh design in view; this paper will, therefore, in the main be historical, and as we go along we shall look out for any lessons or truths that can be picked up.

The fine adjustments of early Microscopes, viz. those constructed towards the end of the 17th and the beginning of the 18th centuries, were of a very crude type, and need not detain us long. First, we have those of the Hooke (**1**) type, consisting of a wooden screw in a collar; this form covers a large number of Microscopes, viz. those constructed by Galileo (**2**), Bonannus (**3**), and Campani (**4**), and many more made at Nürnberg and Augsburg, date 1665–1700. Next, we have a simple screw, used by Leeuwenhoek (**5**), 1673, adopted by Musschenbroek (**6**) and Cuno (**7**), 1702, and in Smith's (**8**) catoptric Microscope, 1738.

Then there comes the brass screw barrel of Hartsoeker (**9**), 1694, and Wilson (**10**), 1702, a very popular form. A fine example of one of these was presented this year to the Society by our Treasurer. The last of this type is the Wilson (**11**) screw barrel mounted on a scroll limb, made by Jones, 1798. At this time we also have the Wilson (**12**) compass Microscope, with screw-nut focussing, 1702, adopted by Joblot (**13**), 1718, and Lieberkühn (**14**), 1740. Marshall's (**15**) Microscope had a screw and a nut, 1704, and may come into this class. Next, we meet with a rackwork stage focusser in Hertel's (**16**) Microscope, 1715; the rackwork is actuated by the right-hand ornamental butterfly nut in front of the stand; the left-hand nut rotates the stage; and the centre one gives it motion to and from the pillar.

Passing over the Culpeper and Scarlet (**17**), 1738, and the Benj. Martin (**18**) drum Microscope, 1739, which had no fine adjustments, we come to an entirely new pattern in Lindsay's (**19**), which was a stage focusser by means of a lever; patented 1743, but alleged to have been made in 1728.

We can now leave these elementary devices and pass on to the first good form of the early Microscope, which was undoubtedly that of Cuff (**20**) of 1744. Here we find a modification of Marshall's, but one of altogether superior workmanship; the nut is dispensed with, the screw itself being turned by the milled head. This Micro-

* Journ. R.M.S., 1899, p. 256.

scope was still made in 1798. In 1747 we have a stage focusser by Adams (**21**), with the nut placed at the bottom of a vertical pillar; and in 1771 the variable Microscope (**22**), by the same maker, constructed from the designs of a nobleman who did not want his name to be published. Here we have both a coarse and a fine adjustment, but only one slide; so that when the coarse adjustment is used, the fine adjustment has to be put out of action by releasing a clamping-screw; also when the fine adjustment is clamped up for use, the rack of the coarse adjustment is obliged to turn the coarse adjustment pinion. A similar arrangement is found in a Microscope by Benj. Martin (**23**). In this same year, 1771, a very handy instrument called the "Compendious Pocket Microscope" was made by Adams (**24**), probably one of the best of these old instruments; it was a body focusser by rack-and-pinion. In 1776 Benj. Martin (**25**) brought out a somewhat more elaborate form, as a counterblast to Adams's of 1771; one of these was presented by Dr. Dallinger to the Society at our last meeting. The Microscopes succeeding these were rack-and-pinion stage focussers; an important example by Adams (**26**) was presented to the Society at the last meeting by Mr. J. M. Offord. This type of Microscope culminated in the "Jones' most improved" (**27**) of 1798. The following Microscopes also had no fine adjustments:—Fraunhofer's drum Microscope (1815); this model was subsequently adopted by Chevalier (**28**), and Lerebours, of Paris, and about 1840 was a very popular form; Selligue's (**29**), 1824, was a rackwork stage focusser; Lister's (**30**), 1826, a rackwork body focusser; Goring's (**31**) "Operative Aplanatic Engiscope" (March 1829) a body focusser by rack-and-pinion, a triangular bar racking out of a cylindrical rod; the first Microscope in which this excellent idea was carried out. In connection with this Microscope Dr. Goring makes this remarkable statement: "If the present stand was made to operate solely with an engiscopic refracting body, it would be better to omit the rackwork of the upright bar altogether, and substitute a pinching-screw for it, giving a fine movement to the body within the neck of the arm by a screw on Ramsden's princple." Now the "screw on Ramsden's principle" was a differential screw; so here we have the first suggestion of its application to a Microscope.

We will now examine some Continental models. Chevalier (**32**), 1834, coarse adjustment to stage by rackwork, and fine adjustment to stage by screw, the screw being similar to Cuff's. Schiek (**33**), coarse adjustment to body, and fine adjustment to stage, screw action similar to Cuff's. Pistor (**34**), a sliding coarse adjustment, fine adjustment by a clamping-screw fitted in a manner similar to the older forms of Benjamin Martin, and the variable Microscope of Adams, so that before using the sliding coarse adjustment, the fine adjustment had to be thrown out of action by releasing the clamping-screw. These Microscopes may be dated about 1830. Prof. Amici (**35**) designed a Microscope about 1835, with rackwork stage coarse adjustment, and screw stage fine adjustment, which was almost identically the same as that of Chevalier's. We now come to the Oberhauser Microscope, about which there has been some controversy. Oberhauser (**36**) designed a Microscope with rackwork coarse adjustment fitted to the body-tube, and rackwork to the draw-tube, but with no fine adjustment; this instrument was called a dissecting Microscope, its date is probably as early as 1835. Oberhauser made two other models; one (**37**) had the rackwork transferred from the body to the pillar, the body being fitted with a push-tube, and a fine adjustment added by means of a screw on the top of the pillar acting against a spring; this Microscope was patented in 1837. In another (**38**) Microscope, the rackwork coarse adjustment was entirely removed, the push-tube coarse adjustment being retained, and the screw-nut of the fine adjustment placed at the bottom of the pillar. In all these models the limb which held the body was attached to the rotary stage, so that when the stage was rotated the body was rotated with it. This plan was for some years adopted by Messrs. Zeiss; but it is now entirely given up in favour of the English form of concentric rotary stage designed by M. S. Legg in January 1848. It is not quite clear which of these three forms of the Oberhauser was the earliest; the order given in the text is probably that most generally accepted. Two points of originality in design can be credited to Oberhauser: 1st, the fixing of the limb to the rotary stage; 2nd, the fitting of rackwork to the draw-tube. (This was employed solely for the regulation of the magnifying power; it was, however, re-introduced by me some years ago for the purpose of lens correction, and it has now, in this country at least, become very general.)

To sum up, therefore:—From the year 1771 to the point we have now reached, we find nine types of Microscopes without any fine adjustment, and six with; and of the six which had fine adjustments, five of them had nothing better than that designed by Cuff in 1744. The best fine adjustment we have met with as yet is that of Oberhauser's screw-nut acting against a spring (patented 1837). We shall, however, be able to predate this by better forms invented in this country.

One of the workers to whom we are to-day indebted for many improvements in the mechanical portion of the Microscope is Cornelius Varley; but so far as I am aware, his work has never been recognised by any writer. Mr. Mayall, for instance, in his Cantor lectures, says, "I purposely exclude Cornelius Varley, for, in my opinion, most of his contributions to the mechanism of the Microscope bordered so much on the bizarre, that their influence has retarded rather than advanced the best points of construction." I think, however, that when you have heard the evidence I have to bring before you, you will reverse this view of the case. It is not sufficient merely to look at the outside form or shape of any particular instrument, and if such prove to be of a bizarre nature, to discard all further notice of it, but it is necessary to examine carefully all the separate movements and various parts, and see if they embody any mechanical contrivances that have added their quota to the evolution of the modern Microscope. Cornelius Varley's work is to be found in the Transactions of the Society of Arts. A great number of the plates, both of Microscopes and of a large assortment of machines used for various industrial purposes, were drawn by him. Respecting the Microscope drawings, with which only we are concerned, they are the best drawings that have ever been published on the subject, plans, elevations, and sections being given of the more complicated parts. So at the outset we see that whatever failings Varley may have had, ignorance of mechanical principles was not one of them.

The following is an extract from the opening lines of his first paper (there is no date to this paper, but Dr. Solly's supplement to it is dated 1831):—"Very early in life I was employed in making Microscopes and the lenses for them." . . . . "On this account, and the defective adaptation of most Microscopes for particular purposes, I again made one for myself, believing I could fit it much better than those hitherto in use, for viewing living objects with the very highest powers."

From the above we may safely infer that this Microscope, together with its lenses, was made by Cornelius Varley (**39**) not later than 1831. The instrument was a simple non-achromatic Microscope, achromatism not having become completely established in this country at that date. It is not my intention to wander outside the scope of this paper by describing this instrument, but will merely state in passing that it was the first Microscope to have a calotte rotating nose-piece and a cylinder diaphragm, both of which contrivances are used at the present time. The coarse adjustment is performed by sliding the stage up and down the pillar, and fixing it by means of a clamping-screw. But it is with the fine adjustment that we are concerned at present; in this Microscope it is of the direct-acting screw type, and the milled head, by which it is set in action, is placed at the lower end of the pillar. Varley says, "There are two faults attendant on this screw, both of which will increase, unless counteracted; one is wearing loose at the shoulder which confines it to the bottom, the other is a wearing of the threads of the solid and hollow screw: each of these causes a loss of motion, by permitting the screw to turn a little without moving the sliding tube. I will therefore describe the means of curing these defects: To remove all end-shake that would occur from the shoulder wearing, a short spiral or other spring is placed on the milled nut to act between it and the seat on which the screw-holder rests; this keeps the screw always down on the seat, and thus prevents end-shake, whether the screw is turned one way or the other. The other fault, which is occasioned by the screw wearing loose in its hole, thereby enabling it to make a portion of a turn without pushing or pulling the tube, is sometimes coarsely cured by splitting the screw-hole, and making the two halves spring towards each other, so as to pinch the screw between them. A better mode than this is shown in the figure; on the screw is placed a separate screwed nut, a little way below the bottom of the sliding tube, and two pins or screws pass through it into the tube, merely to prevent its turning round. This nut is to be urged from the tube by interposing a spiral or other sort of spring between them: this arrangement will keep the tube always pressing upwards against the screw threads."

For certain other reasons Varley modifies in a slight degree this plan; it is not, however, sufficiently important to quote at length; but further on he points out that the graduation of the milled head will enable the thickness of objects to be measured. So in this first Microscope of Varley's design and make, we have no less than four contrivances, which are in use to-day:—1st, calotte rotating nose-piece; 2nd, cylinder diaphragm; 3rd, sprung fine adjustment; 4th, graduation to milled head of fine adjustment. All these four items are original, and the first instances of their use in any Microscope, made either here or on the Continent.

The next Microscope we come to was made in March 1831, but subsequently to that of Varley's, as we shall presently see. It was designed by Mr. W. Valentine, of Nottingham (**40**), to whom a large silver medal was granted by the Society of Arts, and was made by Andrew Ross. The Microscope was both simple and compound, it was non-inclinable, the foot was a folding tripod, the coarse adjustment was accomplished by racking a triangular bar out of a vertical post, the stage was strengthened by struts for dissecting purposes, and was fitted with mechanical rectangular movements. The fine adjustment was a direct-acting screw, fifty threads to the inch (suggested by Dr. Solly), actuated by a milled head placed at the bottom of the pillar, the milled head being graduated into 100 divisions. Now we come to the important part, which I will give in Mr. Valentine's own words: " . . . . end-shake being prevented by the spring. The action of this sort of spring is fully explained in the account of Mr. Varley's Microscope." So here we have a Microscope designed by Mr. Valentine, and made by Andrew Ross, in the description of which there is an acknowledgment that the springing of the fine adjustment is due to Mr. Varley.

The next fine adjustment we have to consider was applied to the stage by H. Powell (**41**); for this the Society of Arts, in 1834, awarded a silver medal to him. The method by which this adjustment was effected was quite novel, for by means of a micrometer screw three wedges were moved underneath a Turrell stage, causing it either to rise or fall with a very slow parallel motion; one turn of the micrometer screw causing a movement of 1/300 in., which is one-sixth that of Valentine's. One of these Microscopes made before the year 1841 is in my possession; and I can testify to the steadiness and precision with which this fine adjustment still works; one revolution of the milled head gives a movement of 1/670 in.

We now come to the short-lever fine adjustment on the nose-piece, in connection with which there are two points I am quite unable to elucidate, viz. the name of the inventor, and the date of its introduction. The first time we meet with it is in a description of a Microscope made by Andrew Ross (**42**), published in 1839; but we know that it was the common form of adjustment for the Microscopes of nearly all the makers about that date. Powell must, however, be excepted, as he used it only for his cheapest form of stand. Although it was a most inefficient form of fine adjustment, it was very generally employed for upwards of forty years. The lever was one of the second order.

On the Continent, from about 1835, we meet with a number of Microscopes which had tilting stage fine adjustments (**47**). One side of the stage was hinged, while the opposite side was capable of being either raised or lowered by a screw. This was the usual form, but there were some modifications of this plan. Owing to the cheapness of this crude construction, this fine adjustment was very popular on the Continent; it has now quite disappeared, and it had no influence whatever on the evolution of the Microscope.

In 1841, three Microscopes were purchased by this Society; those made by Messrs. James Smith (**43**) and Andrew Ross (**44**) had short lever nose-piece fine adjustments; but Powell's (**45**) was on the stage-focussing principle just described. One revolution of the milled head in J. Smith's Microscope gives a movement of 1/150 in. to the nose-piece, and 1/120 in. in the Andrew Ross.

In this same year (1841), Powell (**46**) had brought out a new kind of fine adjustment, which was adapted to a Microscope with a Lister limb; this fine adjustment had a steel cone at the end of the micrometer screw, this cone acted on a nose-piece against the pressure of a spring. Powell, however, soon abandoned this form of Microscope with the Lister limb in favour of the bar movement. In 1843 he introduced his tripod foot holding a long lever bar movement Microscope (**48**). The long lever was of the first order, and was actuated by an advancing cone. Subsequently, about 1847, he abandoned the advancing cone and placed the micrometer screw on the top of the bar (**49**), immediately behind the screw forming the pivot and attachment of the bar to the prism-shaped rod; this is the fine adjustment that is still made by the same firm (one revolution causing a movement of 1/200 in.).

In 1843, but subsequent to the publication of Powell's long lever, Andrew Ross (**50**) brought out his long lever-bar movement; the lever being of the second order; several examples of this we have in our cabinet; and they are from time to time used in this room.

In this country from 1843 to about 1870, we had four types of fine adjustments, viz. (1) Powell's long lever of the first order (**49**);

(2) Ross' long lever of the second order (**50**); (3) short lever nose-piece (**42**); (4) direct-acting screw on the Hartnack model (**51**).

About 1860, Nobert introduced the differential screw, which was reinvented by the Rev. James Campbell (**52**), 1886, and is now used with satisfactory results by Messrs. Baker and Swift, one revolution causing a movement of 1/200 in. About 1878, Ross (**53**) adopted the Zentmayer (**54**), 1876, an American form of Microscope; it did not however prove successful. In this Microscope the whole body, instead of the nose-piece only, was moved by the fine adjustment.

A direct-acting screw fine adjustment of a novel form was introduced by Messrs. Seibert and Krafft (**55**) in 1876; the body was attached to the vertical pillar by a parallel movement, precisely similar to that of a common parallel ruler. A direct-acting screw pressed, through a loose intermediate piece, on an arm rigidly fixed to the body. The ingenious part of this fine adjustment is the loose intermediate piece, which compensates for any lateral movement.

In 1876, Messrs. Bausch and Lomb (**56**) patented a direct-acting screw fine adjustment, in which the body was attached to the limb by two horizontal and parallel steel springs, the body being moved by a screw working directly upon it. This plan was merely a simplification of the previous form. It was further improved in 1887 by Messrs. Swift and Son (**57**), who added a lever movement to it.

In 1881, Messrs. Swift and Son (**58**) introduced their vertical long lever fine adjustment, which worked only the nose-piece, one revolution causing a movement of 1/300 in. Subsequently this was constructed so that it moved the whole body. The manner in which this was effected differed from that of Zentmayer's; for Swift supplied a wide slide with V-grooves, thoroughly well sprung, so that a steady and equable movement was obtained (**59**).

In 1886, Messrs. Zeiss (**60**), who had hitherto used the Hartnack form of fine adjustment, altered it by making a left-handed micrometer-screw, which had a hardened steel point, press on a hardened steel plate. This plan, of course, takes all lateral strains off the screw. In this, one revolution of the milled head causes a movement of 1/101 in.; in Reichert's, 1/85; and Leitz, 1/51. In America, where the Continental Microscope has been largely adopted, Messrs. Bausch and Lomb have given a speed of 1/51 in. for each revolution of the milled head; this is seven times quicker than Watson's lever.

In 1889, Messrs. Watson and Son (**61**) adopted the Powell fine adjustment, with the exception that the lever raised the whole body, instead of only the nose-piece, in the same way as Swift's second form of vertical lever did. In 1892, Watson's fine adjustment was altered by making the micrometer-screw a left-handed one, so that the motion of the nose-piece follows the apparent motion of the screw, as is the case with the Continental Microscope, whereas in Powell's plan the motion is reversed. The speed of Watson's fine adjustment is very slow, being 1/350 in. for one revolution. This is three-and-a-half times slower than that of the Continental Microscope; but it will not be found to be at all too slow, because any lens possessing a fair optical index becomes excessively sensitive to focal adjustment when a 3/4 illuminating cone is used. The reason why biologists are content with the quick-moving Continental fine adjustment is because they only employ small cones of illumination, under which conditions lenses are far less sensitive to focal adjustment.

The table of apertures and resolving powers, &c., for many years printed by this Society on a fly-leaf of the Journal, has unfortunately caused a great deal of misunderstanding upon this and other points with regard to the action of lenses. It is tacitly assumed that a lens with a given aperture has both definite penetrating and illuminating powers; this, however, is not the fact, because the table assumes a full illuminating cone in each case. Now, if a full illuminating cone is used with any lens, except it be of the lowest power, such as a 1-in., 2-in., or a planar, the object will become invisible, or nearly so; therefore this list of penetrating and illuminating powers is merely a theoretical abstraction, because the conditions imposed prevent their practical employment. It is never realised that a 1/6 of N.A. 0·8, as used by a biologist with a 1/4 cone, is less sensitive to focal adjustment than a 1/2 of 0·5 with a 3/4 cone; the magnifying powers being the same in both cases. It is only those who use their lenses with full battering charges that can appreciate the luxury of a slow fine adjustment; those, on the other hand, who degrade their objectives by employing narrow cones, and who use an oil-immersion 1/12 with a 1/4 cone to view objects that could be better seen with a dry 1/4 and a 3/4 cone, or a dry 1/6 of 0·9 N.A., to examine an object that could be better seen with a 2/3 of 0·3 N.A., may be able to jog along with a quick fine adjustment, but we cannot say that their example is one to be imitated.

In conclusion, let me say that I have not thought it advisable to insert any figures in this paper to illustrate the fine adjustments on the sixty Microscopes mentioned; it was impossible to publish them all, and a selection would not be of much use. A bibliography is therefore appended showing where these illustrations may be found in a few well-known books easily accessible to all.

Bibliography.

The following references will be found in Quekett on the Microscope, 2nd edition, 1852:—**(3)** p. 8, fig. 4. **(10)** p. 11, fig. 8. **(12)** p. 12, fig. 9. **(14)** p. 15, fig. 11. **(32)** p. 105, fig. 52. **(33)** p. 102, fig. 50. **(34)** p. 104, fig. 51. **(36)** p. 355, fig. 235. **(37)** p. 107, fig. 53. **(40)** p. 61, fig. 38. **(43)** pl. 4. **(46)** p. 75, fig. 43. **(49)** pl. 2. **(50)** pl. 1.

The following will be found in Carpenter on the Microscope, 7th edition, 1891 :—(**1**) p. 130, fig. 95. (**2**) p. 129, fig. 93. (**4**) p. 129, fig. 94. (**5**) p. 134, fig. 101. (**8**) p. 144, fig. 109. (**9**) p. 135, fig. 102. (**15**) p. 136, fig. 103. (**16**) p. 137, fig. 104. (**22**) p. 141, fig. 107. (**27**) p. 143, fig. 108. (**29**) p. 146, fig. 111. (**30**) p. 147, fig. 112. (**41**) p. 152, fig. 117. (**42**) p. 151, fig. 116. (**45**) p. 152, fig. 117. (**51**) p. 210, fig. 162. (**52**) p. 164, fig. 127. (**53**) p. 159, fig. 121. (**58**) p. 162, figs. 124 and 125. (**59**) p. 163, fig. 126.

The following will be found in the Journal of the Royal Microscopical Society :—(**11**) 1899, p. 207, fig. 41. (**13**) 1899, p. 203, fig. 33. (**17**) 1899, p. 205, fig. 36. (**18**) 1899, p. 206, fig. 39. (**19**) 1899, p. 207, fig. 42. (**20**) 1899, p. 208, fig. 43. (**24**) 1899. (**25**) 1899, p. 326, fig. 73. (**26**) 1899, p. 325, fig. 72. (**37**) 1893, p. 601, fig. 92. (**38**) 1893, p. 600, fig. 90. (**44**) 1899, p. 215, fig. 47. (**47**) 1880, p. 882, figs. 97 and 98; and 1888, p. 480, figs. 64 to 73. (**54**) 1880, p. 1072, fig. 137. (**55**) 1880, p. 883, fig. 99; and p. 1047, fig. 116. (**56**) 1881, p. 112, fig. 5. (**57**) 1887, p. 808, fig. 218. (**60**) 1886, p. 1051, fig. 219. (**61**) 1893, p. 93, fig. 3.

Zahn, Oculus Artificialis, appendix, 2nd edition, 1702 :—(**6**) p. 783. (**7**) p. 796, fig. 3.

Adams, Micrographia Illustrata, 1747 :—(**21**) pl. 1.

Chevalier, Des Microscopes, 1839 :—(**28**) p. 3, fig. 6.

Microscopic Illustrations by A. Pritchard, 1838 edition :—(**31**) plate, fig. 7.

Quekett on the Microscope, 1st edition, 1848 :—(**48**) p. 77, fig. 44.

Transactions of the Society of Arts, vol. 48, 1831 :—(**39**) p. 332, pl. 4, figs. 1, 2, 5, 15, 16.

Addendum. May 23rd, 1899.

While the above bibliography was being revised, I received, through Mr. Agar Baugh, a very important communication from

Fig. 95.

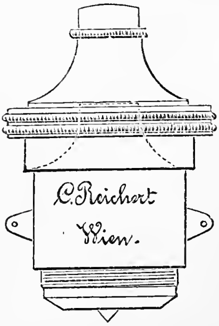
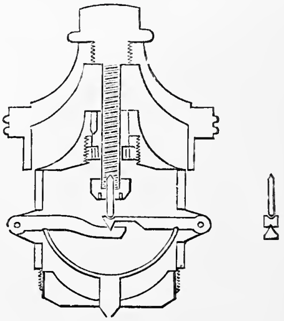


Fig. 96.



Herr Reichert, containing the description of a new fine adjustment for the Continental form of Microscope.

Herr Reichert's patented improvement consists of adapting, in a most ingenious manner, a lever of the second order to the usual direct-acting screw.

Not having seen the instrument itself, I am unable to give the amount by which the movement is slowed down; the drawing shows a ratio of $1 : 2\frac{1}{2}$ in the arms of the lever; therefore, if the screw is of the usual form, the fine adjustment will have a movement of 1/210 in. for one revolution of the milled head, instead of 1/85 in. as at present.

Figs. 95 and 96 illustrate the mechanism so clearly that no explanation is required.

There can be little doubt that this improvement will speedily revolutionise the form of the fine adjustments of Continental Microscopes; for it is evident to all that 1/100 in. for one revolution is too rapid a fine adjustment for any Microscope when critically used.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Egg-laying and Early Development of Sphenodon.‡—Dr. G. Thilenius has studied the habits of *Sphenodon*, both in Stephens Island and in Te Karewa. In the former island the adults live in the burrows of a *Procellaria*, in the latter in those of *Puffinus brevicaudatus*, or in both cases they may also dig their own burrows. The eggs are laid in burrows excavated under tufts of grass, the work of excavation being carried on by the female at night only. Each burrow contains usually twelve eggs, but the number may vary from 9–17. They are packed in the egg-chamber by the help of the mouth, and the entrance is subsequently blocked with earth mixed with stems of grass. Only about one-third of the eggs seem to hatch, the embryos in the remainder dying at an early stage. This is possibly due in part to want of moisture, which is an essential, in part also probably to the pressure produced by the increase in volume of the eggs during development. This increase is due to absorption of water by the albumen. Monstrosities are also relatively frequent. When hatched, the young burrow their way out of the nest, but remain in its vicinity, and do not seek the haunts of the adults till the end of their first year.

The author describes the allantoic canal and the remarkable colour-changes of the embryo in terms similar to those of other observers.

Parietal Eye and Adjacent Organs.§—Prof. Arthur Dendy has studied the development of the parietal eye and adjacent organs in *Sphenodon*, and has been led by his own results and those of others to the following general conclusions:—

(1) The "epiphysis" of Selachians is formed by a pair of equally

* 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, &c., 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 and Reproduction, and allied subjects.

‡ SB. Akad. Wiss. Berlin, 1899, pp. 247–56.

§ Quart. Journ. Micr. Sci., xlii. (1899) pp. 111–53 (3 pls.).

well-developed optic vesicles, originating as outgrowths of the thalamencephalon, and uniting together in the middle line (as shown by Locy).

(2) In Teleosts and *Amia* there is also a pair of epiphysial outgrowths arising in a similar way (with more or less displacement), but the right vesicle alone gives rise to the epiphysis, the left one degenerating (Hill).

(3) In Cyclostomes there is also a pair of epiphysial outgrowths, which suffer displacement so that the right vesicle comes to overlie the left. The right forms the parietal eye, the left one the "parapineal organ." These two, together with the nerve of the parietal eye, constitute the "epiphysis" (compare Ahlborn, Beard, Gaskell, Studnička).

(4) In *Sphenodon* and Lacertilia the epiphysis is a composite structure in which the paraphysis and "Zirbelpolster" take a very large share, while the parts which correspond to the paired epiphysial outgrowths of fishes take a very small one. These outgrowths originate, however, very much as in fishes, and are subject to more or less displacement, and one or other of them may give rise to a parietal eye. In *Sphenodon* it is the left parietal eye which is thus developed.

(5) The right parietal eye is represented in *Sphenodon* by the "parietal stalk." In Lacertilia the parietal stalk represents either the right or the left parietal eye.

(6) The parietal eye has no real connection with the parietal stalk beyond that of fellowship, and is supplied with a special nerve of its own derived from the parietal stalk.

(7) The ancestors of existing vertebrates possessed a pair of parietal eyes, which may have been serially homologous with the ordinary vertebrate eyes.

Influence of Freezing on Hen's Eggs.*—M. Etienne Rabaud reports on certain experiments which he began along with the late M. Camille Dareste. The eggs were placed for half an hour in a mixture of salt and ice, at a temperature of – 18°, and then variously treated.

(1) Some were placed immediately in an incubator at 38°, and left for three days. It was then found that most of them had developed. A third of the number showed living embryos much deformed, or dead embryos with a primitive streak and the beginning of the medullary groove. The others showed blastoderms much extended over the yolk, but without any trace of embryonic differentiation. A few normal forms occurred.

(2) Another set was warmed gradually, but this made no appreciable difference in the results.

(3) In a third set the frozen eggs were not warmed until three days after removal from the freezing mixture, but this made little difference. The majority in all cases showed a blastoderm without an embryo.

The results show that a temperature of – 15° is not fatal, but a lasting and profound perturbation results, viz. proliferation without differentiation. There is, however, evidence of individuality, for some formed abnormal embryos, and a few were normal. Rabaud is led to the suggestion that different kinds of plasm in the egg react differently.

* Comptes Rendus, cxxviii. (1899) pp. 1183–5.

Structure of the Functional Mammalian Ovary.*—Dr. C. H. Stratz has made a detailed series of observations on the changes undergone by the ovary during adult life in *Tupaia javanica*, *Sorex vulgaris*, and *Tarsius spectrum*. In each case he had at his disposal a great number of specimens. He finds that in all cases there is distinct menstruation, but in *Sorex* there is no proof of an outflow of blood. In *Tupaia*, at least, the eggs are mature at the beginning of menstruation, and ready for fertilisation at its end. The number of *corpora lutea* correspond to the number of eggs shed, and there is nothing to differentiate the *corpus luteum menstruationis* from the *corpus luteum verum*. If fertilisation take place, the follicles in the ovary undergo degeneration, and no mature eggs are produced till near the end of pregnancy. Not all the eggs shed into the oviduct are fertilised, so that the number of fresh *corpora lutea* is no evidence of the number of embryos in the uteri. Where the period of heat is well-marked, as in *Sorex*, mature eggs do not seem to be produced except at this period, the follicles undergoing degeneration (atresia) instead of ripening.

The paper is prefaced by an elaborate historical sketch of the observations hitherto made on the mammalian ovary, and contains a mass of detail in regard to its various structures.

b. Histology.

Peculiar Form of Protoplasmic Budding.†—Herr Martin Heidenhain describes a peculiar appearance observed in the epithelial cells of the pregnant uterus in the rabbit. The material was fixed in sublimate, and the author believes that the appearances described were the result of the pathological stimulus exerted by the fixing solution during the few moments which elapsed before the death of the cells. The appearance was as follows:—The protoplasm of the cells became drawn out into finger-shaped processes, one of which projected from the surface of each cell. Not infrequently the end of each process was globular and slightly swollen. This globular region was radially striated, the striations surrounding a granular mass which the author believes to be the microcentrum of the cell. From this microcentrum a fine axial thread could be traced leading down the process towards the nucleus of the cell. If the identification of the granules of the process with the microcentrum be correct, the present observations illustrate the intimate connection between this structure and protoplasmic movements. It is probable also that the position of the microcentrum determines the area in which such protoplasmic movements occur.

Nuclei of the Rod-Cells in the Retina.‡—Dr. A. Schaper returns to a subject which he has previously discussed. In the cat, rabbit, horse, &c., the nuclei in the rod-cells of the retina are cross-striped, owing to the regular disposition of the chromatin. The same has been alleged to occur in man, but it is certainly not the usual disposition, and the probability is that it does not occur in any case. It is suggested

* 'Die geschlechtsreife Saügethiereierstock,' Haag, 1898, pp. 1–67 (9 pls.).

† Arch. Mikr. Anat., liv. (1899) pp. 59–67 (1 pl.).

‡ Anat. Anzeig., xv. (1899) pp. 534–8 (1 fig.).

that the regular arrangement of the chromatin may render the retina more permeable by light, which may be of advantage to nocturnal animals.

c. General.

Development of Blood-corpuscles.*—Dr. C. S. Engel has made a detailed study of the development of the blood during the first half of embryonic life in the pig, and prefixes to his paper a list of the various kinds of red blood-corpuscles as recognised by him, together with a description of their staining reactions. The list includes the following seven forms:—(1) Ordinary non-nucleated red blood-corpuscles, which become red when treated with a mixture of eosin and methylen-blue and orange in Ehrlich's triacid; they are therefore *orthochromatic.* (2) Normoblasts, which are also orthochromatic, but differ from 1 in the presence of a small nucleus. They occur in embryonic life and in anæmia. (3) *Polychromatic* normoblasts which become violet in eosin and methylen-blue and red in triacid. They have a much larger nucleus than 2, and are always present when the orthochromatic normoblasts are present. (4) Polychromatic megaloblasts similar to 3, but with an even larger nucleus; they are not very sharply marked off from 3. (5) Metrocytes, large nucleated cells found only in the earliest embryonic stages. They are divided into two generations, according to their staining reactions and the condition of the nuclei, and are the direct forerunners of 1. (6) Orthochromatic macrocytes which are without nuclei and appear late in embryonic life and in anæmia. (7) Polychromatic erythrocytes which vary in size between 6 and 1. The author then proceeds to describe the blood of different regions of the body in the successive stages of the embryo pig, and the relative number of these elements present in the different stages.

Development of Spermatozoa.†—Prof. Karl Grobben publishes a short paper on the arrangement of the developing sperms in bundles which has been observed in the testes of many different animals, and on the relation of the sperms to the "nutritive" cells of the testes. Both in Vertebrates and in Mollusca the sperm bundles are arranged with the heads pointing outwards and the tails towards the lumen of the organ. The heads of the sperms are in intimate connection with the substance of the nutritive cells, and in each bundle point towards the nucleus of the nutritive cells. The author believes that these cells are undoubtedly nutritive, and that the heads of the sperms are attracted towards their nuclei because here the metabolic processes are most rapid. The arrangement in bundles is explained by the supposition that the nuclei of the sperms exercise upon one another an attraction similar to that which the nucleus of the nutritive cell exercises upon them, and also by the original position of the sperm-producing cells (spermatids). Prof. Grobben is doubtful whether there is any intimate connection between the cytoplasm of the sperms and of the nutritive cell, and believes that the relation is similar to that existing between intracellular parasites, such as *Eimeria*, and the cells which they infest.

* Arch. Mikr. Anat., liv. (1899) pp. 24–59 (1 pl.).
† Zool. Anzeig., xxii. (1899) pp. 104–8.

Origin of Vasa efferentia in Tortoises.*—Herr Friedrich von Möller, in the course of some observations on the urinogenital system of tortoises, examined two young males of *Emys lutaria* and *Clemmys leprosa* respectively 2·5 cm. and 4·9 cm. in length, and found that in neither was there any connection between testes and Wolffian ducts. He found a series of canals which are the future *vasa efferentia*, but which arise neither from the testes nor from the kidneys, but, as he believes, from the peritoneal epithelium. This result is very different from those of most observers on Amniota, who describe the *vasa efferentia* as arising from the genital ridge (Semon, Braun, Hoffmann), or from the kidney (Schmiegelow, von Mihálkovics); but it agrees with Semper's results for Selachians; for the latter describes the *vasa efferentia* as arising there from the nephrostomes which originate from the peritoneal epithelium.

Lorenzini's Ampullæ in Acanthias vulgaris.†—Herr Gösta Forssell has employed modern histological methods in the investigation of the structure of the sensory ampullæ of this dog-fish. In regard to the gross anatomy, reconstructions from serial sections showed that the inner end of the ampulla divides up into a number of fine tubes, which are furnished with numerous (18–31) finger-shaped diverticula. Histologically the diverticula differ markedly in structure from the canal proper. The former are lined by an epithelium composed of two kinds of cells:—(1) supporting cells which anastomose to form a "basketwork" round (2) large pear-shaped cells apparently in close connection with nerve-fibrils. The ampullar canal itself is lined by very peculiar cells, each of which has projecting from its inner surface a long columnar process with a reticular structure, the meshes of the reticulum in life being apparently filled with a semi-fluid substance. These processes project into the lumen of the canal, tend to fuse together, and thus form the gelatinous mass which fills the cavity of the ampulla. The author believes that the ampullæ as a whole are sense-organs, and that the gelatinous contents serve to propagate the sense impressions to the sensory cells of the diverticula, and also to protect those cells from injury. The research being solely histological casts no light on the special nature of the sense involved.

Reproductive or Genetic Selection.‡—Prof. Karl Pearson uses this term to describe the selection of predominant types owing to the different grades of reproductivity being inherited, and without the influence of a differential death-rate.

The problem whether fertility is or is not inherited is one of far-reaching consequences. That fertility should be inherited is not consistent with the organic stability of a community of individuals, unless there be a differential death-rate, more intense for the offspring of the more fertile; i.e. unless natural selection or some other factor holds reproductive selection in check. The inheritance of fertility, and the correlation of fertility with other characters, are principles momentous in their results for our conceptions of evolution; they mark a continual

* Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 573–98 (3 pls.).
† Op. cit., lxv. (1899) pp. 725–44 (1 pl.).
‡ Proc. Roy. Soc., lxiv. (1899) pp. 163–7

tendency in a race to progress in a definite direction, unless equilibrium be maintained by any other equipollent factor, exhibited in the form of a differential death-rate on the most fertile. Such a differential death-rate probably exists in wild life, at any rate until the environment changes and the equilibrium between natural and reproductive selection is upset. How far it exists in civilised communities of mankind is another and more difficult problem, which Mr. Pearson has partially dealt with in one of the essays in his 'Chances of Death.'

In the memoir of which an abstract is published, Prof. Pearson (with the assistance of Miss Alice Lee and Mr. Leslie Bramley-Moore) deduces the following conclusions:—

(1) Fecundity in the brood-mare is inherited from dam to mare.

(2) It is also inherited from grand-dam to mare through the dam.

(3) The latent quality, fecundity in the brood-mare, is inherited through the sire; this is shown not only by the correlation between half-sisters, but by actual determination of the correlation between the latent character in the sire and the patent character in the daughter.

(4) The latent quality, fecundity in the brood-mare, is inherited by the stallion from his sire; this is shown not only by the fecundity-correlation between a sire's daughters and his half-sisters, but also by a direct determination of the correlation between the latent quality in the stallion and in his sire.

The authors are led to the conclusion that fertility is inherited in man and fecundity in the horse, and therefore probably that both these characters are inherited in all types of life. It would indeed be difficult to explain by evolution the great variety of values these characters take in allied species if this were not true. That they are inherited according to the Galtonian rule (of ancestral inheritance) seems probable, though not demonstrated to a certainty.

Regeneration.*—Prof. August Weismann, in his recent essay on this subject, reviews certain recent regeneration experiments, and discusses their bearing on his previously expressed views on the subject. According to these views, regeneration is not an immediate and necessary expression of the nature of the organism, but is an adaptive phenomenon, present wherever an organ of great biological importance is liable to loss or injury in the ordinary course of life. This position obviously demands two sets of proofs. It must be known, firstly, that all parts capable of regeneration are liable to be lost under ordinary conditions, and secondly, that organs not so liable are not regenerated. Among the latter Prof. Weismann includes internal organs which are not renewed after injury. Among organs which are renewed, but which have not hitherto been shown to be naturally liable to injury, are the jaws of the stork (renewed after accidental injury) and the lens of the eye in newts. But it has been recently shown by Bordage that the beaks of cocks are frequently injured during cock-fighting, and are then renewed. This suggests the possibility that the same accident may occur in the stork, where the males are also great fighters. In the case of newts, Prof. Weismann finds that the head, and possibly the eye, are often injured by the larvæ of *Dytiscus marginalis*.

* Anat. Anzeig., xv. (1899) pp. 445–74; and in Nat. Sci., xiv. (1899) pp. 305–28.

In a criticism of observations on regeneration in hermit-crabs by Morgan,* Prof. Weismann somewhat modifies the statements just made, by admitting that the regeneration of the abdominal appendages in the hermit-crabs does not prove that these appendages are now liable to injury, but merely that they formerly were so liable, or that their power of regeneration may be an inheritance from the worm-like ancestor of the Crustacea, which had doubtless a well-developed diffuse power of regeneration.

The fact that in some cases in Insects and Crustacea the appendages which are regenerated are of an older type than those lost, shows, according to Prof. Weismann, that the power of regeneration depends upon the existence of regeneration primordia. After some further discussion of these primordia, Prof. Weismann passes to the general discussion of his theory of heredity. In the course of this he reaffirms his belief in the occurrence of "reducing-divisions" in the maturation of both male and female germ-cells, and defends himself against those who object to the want of stability in his views.

Regeneration in Crustacea.†—Herr Hans Przibram has made a prolonged series of observations on this subject in the fresh-water Entomostraca. He also summarises the observations of others on other Crustacea, and gives a table illustrative of the distribution of regenerative power in the animal kingdom. His conclusion is that the power of regeneration is primitive, and tends to disappear as specialisation advances. Further, in accordance with "the fundamental biogenetic law," the individual tends to recapitulate its race-history, and therefore the power of regeneration is greatest in early life, and gradually diminishes during the course of the life-history.

Variations in the Plankton of Lake Geneva.‡—Prof. Emile Yung estimated these every fifteen days or so during 1898, and has reached the following conclusions:—

(1) The distribution is in no way homogeneous; it varies from place to place, both horizontally and vertically, chiefly through the formation of swarms.

(2) The plankton extends to 200 metres, even below the "light-limit." Abundant Cladocera (*Daphnia* and *Sida*) were got from 150–200 metres.

(3) The quantitative maximum is in May and June, when the water had a superficial temperature of 13°–14°. The minimum is in March and September, but there seems to be an autumnal maximum in November or December.

(4) Apstein's net was used, but its defects are great; so great that the results cannot be said to have more than relative value. Hensen's coefficient of filtration, intended to correct errors, is illusory in a lake where the composition of the plankton varies from month to month.

Lake and Pond.§—Dr. O. Zacharias has inquired into the difference between a lake and a pond. The criterion is usually found in depth.

* Zool. Bull. Boston, i. (1898).
† Arbeit. Zool. Inst. Univ. Wien, xi. (1899) pp. 163–94 (4 pls.).
‡ Comptes Rendus, cxxviii. (1899) pp. 1128–30.
§ Biol. Centralbl., xix. (1899) pp. 313–9.

Thus Chodat, in his 'Études de Biologie lacustre' (1898), says that a true lake must not be less than 20–30 metres in average depth, while a true pond must not exceed about 15 metres. Intermediate basins may be called "lake-ponds," "Seenteiche," "lacs-étangs." But are there not biological criteria?

In lakes the plankton is much less diverse, and the dominant floating Algæ are different. In ponds, Protococcaceæ, Palmellaceæ, certain Desmids (*Closterium cornu*, *Cl. pseudospirotænium*, &c.), certain Schizophyceæ (*Anabæna*, *Aphanizomenon*, and *Polycystis*) are much more abundant than in lakes. Another feature of ponds is the relative sparseness of diatoms in the micro-flora. Characteristic of ponds are such forms as *Scenedesmus*, *Pediastrum*, and *Rhaphidium polymorphum*.

Species of the rotifer *Brachionus*, abundant in the "Helioplankton" of ponds, are relatively rare in lakes; and *Schizocerca diversicornis* and *Pedalion mirum* are also distinctively shallow-water forms. The author gives many other examples.

Plankton of Swiss Lakes.*—Herr G. Burckhardt has investigated a large number of lakes, and gives lists of the Rotifera, Cladocera, and Copepoda, with appended systematic and distributional notes.

Period of Sexual Maturity in Marine Animals.†—Dr. S. Lo Bianco has published a list of a large number of animals from Porifera to Pisces, in which he states the period of sexual maturity as observed in the Gulf of Naples. The list represents a big piece of work, and will be of much use for reference.

Relation of Fauna to Bottom-Deposits.‡—Mr. E. J. Allen has studied the relation of the fauna to the bottom-deposits along the thirty-fathom line from the Eddystone to Start Point. The causes which influence the distribution of life on the sea-bottom are discussed under two heads:—(1) *Physical*, the constitution of the sea-water, the nature of the bottom-deposit, the movements of the water, the temperature, the pressure, and the light; and (2) *Biological*, the advantageous and disadvantageous influences of animals upon one another. The bottom-deposits are grouped in eight grades:—stones, coarse gravel, medium gravel, fine gravel, coarse sand, medium sand, fine sand, and silt. Mr. Allen gives a vast array of tables showing the distribution of animals on the different grounds, and communicates a large number of faunistic notes.

Teeth of Fish.§—Mr. J. H. Mummery has examined the teeth of *Echeneis squalipeta*, and finds them to display several peculiarities. The lower jaw projects so far in front of the upper that the teeth of the latter, when the mouth is closed, lie within those of the former. These projecting teeth have spatula-shaped crowns and are strongly recurved; it is suggested that they may be used to scrape off parasites from the skin of the sharks to which the sucking-fish attaches itself. All the other teeth have simple conical crowns with recurved tips. The teeth are attached to the bones by a modified ball-and-socket

* Zool. Anzeig., xxii. (1899) pp. 185–9.
† MT. zool. Stat. Neapel, xiii. (1899) pp. 448–573.
‡ Journ. Mar. Biol. Ass., v. (1899) pp. 365–542 (16 charts).
§ Trans. Odontolog. Soc., xxxi. (1899) pp. 62–77 (2 pls.).

joint, with a capsule strengthened anteriorly and posteriorly by fibrous bands.

Ancestry of Mammals.*—Messrs. J. S. Kingsley and W. H. Ruddick have made a series of investigations on the ear-vesicles of various Vertebrates from Amphibians to Mammals, and discuss the bearing of their results on the question of the origin of Mammals. They regard the incus of Mammals as the homologue of the quadrate, the body of the malleus as the articulare, but they do not believe that the mammalian condition of parts can be derived from the reptilian. On the other hand they find much resemblance between the mammalian ear and that of Urodeles, and believe that Mammals have originated from a form not far removed from the Urodele stock. They entirely reject the suggestion of origin from the theromorphous reptiles.

Colour-Change in Lizards.†—Mr. P. De Grijs begins by inquiring into the qualities in respect of which the skin of some reptiles has the power of colour-change. It seems as if it would have been advantageous to some snakes, but it is found in none. In Lacertilia it is sporadically distributed. He goes on to note how the power of colour-change in Lacertilia differs in intensity and frequency. Two groups can be established:—(A) those in which ground-colour and marking alter equally in tone, but the marking does not disappear; (B) those in which ground-colour and marking each alter in tone independently of the other, and the spots may entirely disappear. As to utility, three main uses may be distinguished:—(*a*) for protection against enemies (e. g. in agamas and geckos); (*b*) for absorbing or warding off heat (e. g. in chamæleons); (*c*) in connection with sexual selection (e. g. in *Agama inermis* and *Sceleporus undulatus*).

Physiology of Secretion.‡—Mr. Albert Mathews has considered the evidences of the existence of secretory nerves, and the reasons for believing that secretion is a function of the gland-cells. While admitting the possibility that secretion may, in certain instances, be a function of the gland-cell, controlled by the action on it of secretory nerve-fibres, he finds reason to believe that many so-called secretions are due not to the gland-cell, but to the action of contractile tissue either within or about the gland. Among such secretions are the salivary secretions following stimulation of the sympathetic, certain secretions of sweat, the secretion of the cephalopod salivary glands and of the skin-glands of Amphibia.

His summary of results includes the following among other conclusions:—(1) The sympathetic nerve induces salivary secretion by acting on contractile tissue in the glands, and thus causing a compression of ducts and alveoli; (2) the *chorda tympani*, or other dilator salivary secretory nerve, probably causes secretion by its dilator action on the blood-vessels, thus increasing osmosis; (3) the evidence that the *chorda tympani* acts on the gland-cells is open to serious objections, which are detailed; (4) the sweat-glands and the amphibian skin-glands, like the salivary glands, receive a double nerve supply, and probably

* Amer. Nat., xxxiii. (1899) pp. 219–30.
† Ann. Nat. Hist., iii. (1899) pp. 396–402. Trans. fr. Zool. Garten, xl. (1899) pp. 49–55.
‡ Ann. New York Acad. Sci., xi. (1898) pp. 293–368.

possess a double mechanism of secretion, i.e. a muscular and an osmotic; (5) whether secretory nerves exist or whether secretion is ever a function of the gland-cell, must be considered at present an open question.

Present Status of Anatomy.*—Under this title Prof. J. Playfair McMurrich publishes an interesting historical account of the progress of the science from the time of Vesalius to the present day. His conclusions may be gathered from the following sentences:—"In the past, anatomy was human anatomy; to-day, it is synonymous with morphology." "Descriptive anatomy is not necessarily a science; it constitutes merely an aggregate of facts upon which deduction may act; and it is the sum-total of the observations and deductions that constitutes the science."

Tunicata.

Appendiculariidæ of the Straits of Messina.†—Dr. H. Lohmann has made extensive series of observations on the minute forms of the surface waters in the Straits of Messina, with a special view to determining the causation of the seasonal variations in number, and the character of the forms found at different seasons. In the neighbourhood of Messina 26 species of Appendiculariidæ were found, mostly those characteristic of equatorial waters, but including also typical forms of *Fritillaria borealis.* The mixed character of the fauna was further emphasised by northern forms of *Ceratium.* By the use of closing nets at various depths, it was proved that the periodic partial disappearance of the Appendiculariidæ, already familiar to Mediterranean naturalists, is confined to the superficial layers of water, all the characteristic forms being present in the lower layers. The cause the author believes to be not variations in temperature acting directly, but variations in the amount of Plankton Algæ. Observation showed that the period of great faunistic wealth is preceded by the growing period of the Algæ. The Algæ reproduce rapidly, and the active forms rise to the surface in search of them, and being well fed reproduce rapidly. As the Algæ diminish in number, the Appendiculariidæ and the other forms diminish also in number, and sink to the lower layers of water. A depth of 100 metres seems to be the limit to which the Appendiculariidæ sink.

Four species of *Challengeria*, which has not hitherto been described for the Mediterranean, were discovered during the observations.

Epicardium in Ciona intestinalis.‡—D. Damas has investigated the character, relations, and development of the space which surrounds the viscera in this tunicate. He finds that it is double and not single as previously described. The two spaces do not communicate with each other, but open into the branchial sac by two orifices. They are of very unequal size, the left being much larger than the right. The author believes that these two spaces together correspond to the epicardium as described by Van Beneden and Julin in *Clavelina.* Willey's statement that the epicardium is wholly absent in *Ciona* is explained by the fact that the organ, as above defined, develops at a late period and was not

* Amer. Nat., xxxiii. (1899) pp. 185–98.
† SB. Akad. Wiss. Berlin, 1899, pp. 384–400.
‡ Arch. Biol., xvi. (1899) pp. 1–25 (3 pls.).

present in the stages described by him. The epithelium of the left epicardial cavity is continued into the vessels of the test, and presents the characters of the stolon of the compound and social Ascidians, except that it does not produce buds. The relation of the epicardium of *Ciona* to that of *Clavelina* shows, in the author's opinion, that the latter is a more highly specialised type than the former, and that the epicardial organ consists primitively of two parts:—(1) a respiratory cavity in communication with the branchial sac, and (2) a stolon. In *Ciona* both regions are present; but in social and compound Ascidians the latter is greatly developed at the expense of the former.

INVERTEBRATA.

Mollusca.

Excretion in Mollusca.*—Prof. L. Cuénot publishes a comprehensive memoir on this subject based on researches made at Nancy and Roscoff. We can summarise here only the more general of his conclusions. In Mollusca generally there are three sets of excretory organs. Firstly, the nephridia, which eliminate indigo and whose cells have usually an acid reaction. When two nephridia are present they may, as in *Patella*, be physiologically similar, or may be differentiated as in *Trochus* and *Haliotis*, where the right excretes indigo and the left carminate of ammonia. Where one nephridium only is present, it often contains two kinds of cells, those which are ciliated and excrete carminate of ammonia and the non-ciliated which excrete indigo. Secondly, in Amphineura, *Dentalium*, and Gastropoda, there are scattered cells in the connective tissue which are excretory in function, and correspond to the pericardial glands of Lamellibranchs and the branchial hearts of Cephalopoda. All these cells have an acid reaction and excrete carminate of ammonia and tournesol. Thirdly, in certain Gastropods the liver contains excretory cells which shed their products into the intestine. The Lamellibranchs furnish an admirable example of a mode of excretion common in Invertebrates, where excretory cells secrete waste products which are subsequently taken up by the phagocytes of the blood and carried to special regions of the body. This "bastard" process of excretion the author regards as a striking example of the imperfect functioning of organs, the storing-up of the waste products within the body being highly disadvantageous to the individual and destructive of the necessary co-ordination of parts.

The methods employed were by physiological injections of colouring matters; and the paper includes a discussion of the value of the method, illustrated by comparative tables.

γ. Gastropoda.

Molluscs of Great African Lakes.†—Mr. J. E. S. Moore, in his third paper on this subject, deals with *Tanganyikia rufofilosa*, *Spekia zonata*, and in a fourth paper with *Nassopsis* and *Bythoceras*, all from Tanganyika. All the evidence, he says, which has been afforded concerning the nature of these halolimnic Gastropods points to their vast antiquity.

* Arch. Biol., xvi. (1899) pp. 49–96 (2 pls.).
† Quart. Journ. Micr. Sci., xlii. (1899) pp. 155–85 (6 pls.), 187–201 (2 pls.).

First we have the wide dissimilarity of their empty shells from those of any living types; next their rigid isolation to a solitary great lake of enormous age; next their wonderful similarity to those left fossilised at the bottom of the old Jurassic seas; and lastly their morphological characters like those of incompletely developed embryos.

Dimorphism in Molluscs.* — Dr. E. G. Conklin publishes some interesting observations on variations in form in the species of *Crepidula*. In the large and sedentary species, such as *C. fornicata* and *C. plana*, the shape of the shell varies according to the surface upon which the animal fixes itself, but there is no evidence that these modifications of form are inherited. In the last-named species, *C. plana*, there is a constant dimorphism which cannot be directly referred to a mechanical factor. The species occurs in shells inhabited by *Eupagurus Bernhardus*, and also in those inhabited by the little hermit crab *Eupagurus longicarpus*. In the latter case the individuals are dwarfs, having a body volume which is only 1/13 of that of the other more typical form. Examinations showed that the size of the cells is the same in the two forms, but the dwarfs contain fewer cells than the other, and produce many fewer eggs. The difference is not inherited—the two forms are physiological and not morphological varieties, but the author believes that the differences are not dependent upon pressure or upon relative supplies of food and oxygen, but on some other unknown factor. Further, the same species of *Crepidula* shows marked sexual dimorphism, the female being much (about 15 times) larger than the male. The males retain throughout life the power of locomotion possessed by the females only in the young stage.

The author's special point is that the factor which determines size does so by inhibiting cell-growth and division, and that for *Crepidula* at least the explanations of the cessation of growth put forward by Semper and De Varigny respectively are not valid.

Primitive Kidney of Pulmonates.† — Dr. Johannes Meisenheimer has investigated this structure in the embryos of members of both the Basommatophora and the Stylommatophora, and finds that, different as the organ appears in the two groups, it can in both cases be reduced to a common type. This type consists of a simple tube ending internally in a ciliated cell; from this typical form divergence takes place in two directions. In the Basommatophora the number of cells is limited to four, and of these one, the giant-cell, is the true excretory cell, the other cells being probably of importance only in the transportation of the excretory products. The ciliated cell also retains its primitive excretory function, but is chiefly of importance in facilitating the outward current by means of its cilia. In the Stylommatophora specialisation is chiefly shown in the great increase in number of the cells which constitute the tube, and which are all excretory in function. The ciliated cells also increase in number, and gradually lose most of their excretory importance. No great importance is to be attached to the fact that in the Basommatophora the canal of the kidney is intracellular, while in Stylommatophora it has a distinct epithelial lining. The primitive

* Proc. Acad. Nat. Sci. Philadelphia, 1898, pp. 435–44 (3 pls.).
† Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 709–24 (1 pl. and 4 figs.).

kidney shows a great resemblance to the end-cells of the excretory system of Turbellaria, and, in the author's opinion, the resemblance is such as to confirm the view that Mollusca arose from a Turbellarian-like ancestor.

Egg-capsules of Gastropoda.* — Mr. J. T. Cunningham in a short note describes the process of egg-laying in *Buccinum undatum*, and states that the egg-capsules are formed by the sole-gland of the foot, which is thus to be regarded as a nidamental gland. He has noticed the same thing in *Murex erinaceus*, and believes that the egg-capsules of Azygobranchs will be found to arise always in this way.

δ. Lamellibranchiata.

Cephalic Eyes of Lamellibranchs.†— Prof. Paul Pelseneer briefly summarises his observations on this subject. He finds that in certain genera of Mytilidæ, and of the related genus *Avicula* (exclusive of *Meleagrina*), a pair of cephalic eyes occur, which are simple pigmented pits with a cuticular lens. They occur both in the larva and in the adult, but may not appear in the larva until the formation of the anterior branchial filaments. In the larva they are placed beneath the posterior border of the velum; in the adult, on the first filament of the gill-plate. They are probably homologous with the larval eyes of *Chiton*, and not with the cephalic eyes of Gastropods.

Arthropoda.

α. Insecta.

Pigment Formation in Wings of Butterflies.‡—Herr Franz Friedmann has investigated the development of pigment in the pupa of *Vanessa urticæ*. His results differ, in several respects, from those of A. G. Mayer.§ He finds that the pigment arises from a fatty substance produced by the blood-cells, but the latter do not themselves enter the scales. The formation of pigment can be seen only in preparations fixed with osmic acid, on account of the solubility of the antecedent of the pigment in alcohol. The general plan of the coloration is clearly indicated as early as the fourth day after pupation.

The Orthopteran Genus Schistocerca.‖ — Mr. S. H. Scudder publishes a monograph on this American genus, in which he describes forty-four species.

Seasonal Dimorphism in Lepidoptera.¶—Mr. Roland Trimen, in his presidential address to the Entomological Society, reviews generally the work which has been done on this subject during the last two decades, both on European and tropical forms. He refrains from drawing any general conclusions, but urges the necessity for renewed and more careful observation, especially in the case of tropical forms.

* Nature, lix. (1899) p. 557.
† Arch. Biol., xvi. (1899) pp. 97–103 (1 pl.).
‡ Arch. f. Mikr. Anat., lv. (1899) pp. 88–95 (1 pl.).
§ Cf. this Journal, 1896, p. 514.
‖ Proc. Amer. Acad., xxxiv. (1899) pp. 441–76.
¶ Nature, lix. (1899) pp. 568–73.

Defensive Glands of Coleoptera.* — L. Bordas, from a series of observations, finds that in most Coleoptera there are defensive or anal glands formed of the following parts:—(1) a glandular region; (2) an efferent canal; (3) a vesicular reservoir or receptacle; and (4) an excretory duct. The liquid secreted is expelled by the contraction of the muscular wall of the vesicle, but its discharge is assisted by the contraction of certain muscles affixed to the excretory canal, and by the upward movement of the extremity of the abdomen. The excretory canal and vesicle are lined by the cuticle, and are therefore probably ectodermic in origin; the glands themselves are metameric or appendicular, homologous with salivary glands, poison glands, and genital glands.

Anal Gland of Dytiscus.†—Fr. Dierckx maintains that this has been misinterpreted by Bordas. The anal gland belongs to the unicellular type, and secretes an oily substance which facilitates respiration by keeping the water out of the air-reservoir under the elytra. The defensive apparatus is quite different; it is the rectal pouch which is violently emptied when the beetle is irritated.

Defensive Gland of Brachynus.‡—Fr. Dierckx has a short note on this subject, showing wherein his results differ from those obtained by M. Bordas.§ In *Brachynus crepitans* the gland is double, consisting at either side of secretory lobes, a collecting canal, and a reservoir. The two reservoirs open by minute pores on the dorsal surface of the pygidium. The collecting canals have no muscular coat, as asserted by Bordas. The secretion is limpid, colourless, and has only a faint odour; the author believes that it contains an unknown active principle whose special character is its exceeding volatility. He believes that the liquid boils at a temperature of about + 9° under a pressure of 760 mm. In spite of the colourless nature of the fluid, the discharge stains paper or the skin a brown colour. This fact, and the mechanism of discharge, the author explains as follows:—When the orifices of the glands are opened, the liquid within the reservoir vaporises suddenly; simultaneously the contents of the rectum are voided, and the escaping gas blows the excreta into minute particles, which constitute the solid staining portion of the discharge.

Systematic Position of Pulicidæ.‖—Herr Fr. Dahl briefly recapitulates his reasons for thinking that the Pulicidæ are nearly related to the Diptera and especially to the Phoridæ. He believes that *Scatopse*, *Pulex*, and *Phora* have all arisen from a primitive form to which he gives the name of *Archiscatopse*. This form is regarded as having possessed five-jointed labial and maxillary palps and a simple hypopharynx. He believes further that from the *Phora*-stem lateral branches arose which approximated in character towards *Pulex*, and that *Puliciphora* is an example of such transitional forms.

* Comptes Rendus, cxxviii. (1899) pp. 1009–12. † Tom. cit., pp. 1126–7.
‡ Zool. Anzeig., xxii. (1899) pp. 153–7 (4 figs.).
§ Tom. cit., p. 73. Cf. this Journal, *ante*, p. 157.
‖ Arch. Naturgeschichte, lxvi. (1899) pp. 71–86 (15 figs.).

Position of Pulicidæ.*—Dr. R. Heymons maintains that Dahl's interpretation of the mouth-parts of fleas is not correct, while Kræpelin's is. It has been noted above that Dahl, prompted partly by his discovery of *Puliciphora*, believes that fleas have close affinities with Diptera. Heymons agrees with Kræpelin in an interpretation of the mouth-parts of the two orders which in no way suggests near relationship, and he sums up as follows:—The mouth-parts of Pulicidæ consist, in the larva, pupa, and imago, of an unpaired upper lip, two mandibles, two maxillæ with maxillary palps, and a labium. There is no hypopharynx. The flea does not use the upper lip for piercing the skin of its host, but does this with the mandibles, which are worked by two protractors and two retractors. Morphologically the Pulicidæ deserve to rank as an independent order (Siphonaptera), and *Puliciphora lucifera* is a typical Dipteron (Phoridæ) unrelated to fleas.

Mallophaga.†—Prof. V. L. Kellogg describes numerous new Mallophaga from birds of Panama, Baja California, and Alaska. A second paper by the same and Bertha L. Chapman deals with Mallophaga from birds of California. A third paper by Mr. R. E. Snodgrass presents the results of the first serious attempt to study comparatively the anatomy of these insects. It is hoped that a study of their embryonic and post-embryonic life-history may soon be undertaken.

β. Myriopoda.

Fauna of Caves.‡—Dr. Carl Verhoeff has an interesting paper on this subject with special reference to the Chilopoda and Diplopoda. He believes that both groups were originally blind, and that this blindness has persisted in certain families of both, while it has disappeared in many others. The existence of blind forms in caves is due to the fact that in this environment the blindness has no injurious effect, but the blindness is in all cases primitive, and is not induced by the habitat. The author is of opinion that this statement will be found to have a wider application than merely to the two classes named. Further, he doubts whether such a thing as an absolute cave-fauna exists, for in many cases at least it is certain that the cave-dwellers are washed out of the caves in the rainy season, and are then found as terrestrial forms.

δ. Arachnida.

A Spider of the Dawn.§—Dr. E. A. Göldi describes the habits of *Epeiroides bahiensis* Keyserling—"eine Dämmerungs-Kreuzspinne"—of Brazil, which makes its web in the early morning hours, and rolls it up full of victims as the sun rises. During the day the spider lies hidden under the shade of a leaf, occupied with digestion. Its booty consists chiefly of the small winged males of Coccidæ, and of a species of *Dorthesia* in particular.

Australian Cattle Tick.‖—Mr. C. J. Pound publishes a series of observations on this subject. The cattle tick is described as an "insect,"

* Zool. Anzeig., xxii. (1899) pp. 223–40 (3 figs.).

† 'Contributions to Biology from the Hopkins Seaside Laboratory,' xix. (1899) 224 pp., 17 pls.

‡ Zool. Anzeig., xii. (1899) pp. 157–64.

§ Zool. Jahrb., Abth. Syst., xii. (1899) pp. 160–9 (1 pl. and 1 fig.).

‖ Proc. Roy. Soc. Queensland, xiv. (1898) pp. 28–38.

the author appears to doubt its identity with *Ixodes bovis*, and the paper is disfigured by so many misprints as to render the meaning frequently obscure, but it contains numerous interesting observations on the methods of distribution and the life-history of the pest. The eggs are laid on coarse grass, and the young ticks may be blown considerable distances, attached to leaves or other vegetable matter or to feathers. Goats, kangaroos, and other mammals, many birds, and even man, also assist in distribution. The larvæ have six legs, and attach themselves to each other or to blades of grass with four of these, while the anterior two wave freely in the air, and seize hold of any moving object with which they may come in contact.

ε. Crustacea.

Complementary Male of Scalpellum.* — A. Gruvel describes the structure of *Sc. vulgare*, which in many respects follows that of the hermaphrodite form, though greatly simplified, e.g. in the absence of digestive canal and of specialised vascular and respiratory arrangements. On the other hand, it is of course marked by the enormous development of the male reproductive organs. The author tries to find some answer to the question, how the fertilised ova of the hermaphrodite give rise to two forms so different. It is obviously not an ordinary case of sexual dimorphism. His suggestion is the following. It is well known that in Cirripedia the spermatozoa ripen before the eggs, and it is found that the spermatozoa of the complementary male are usually ripe some time after those of the hermaphrodite. The first ova of the hermaphrodite are probably fertilised in the ovigerous sac by the spermatozoa of the hermaphrodite which have previously accumulated in the interpallial space. As the eggs develop, the holes piercing the ovigerous sac become more oblique and finally close. The sac is detached from the genital atrium and is fixed to the ovigerous frenum. Thereafter some belated eggs are still liberated, and these are probably fertilised by the spermatozoa of the complementary males. On this supposition the author thinks it is easier to understand the dimorphism, for he finds it difficult to believe that similar eggs fertilised by similar spermatozoa could give rise to larvæ which are destined to turn out so differently.

Development of Parasitic Copepoda.† — Herr W. Schimkewitsch publishes a short note supplementing his previous observations on this subject. He finds that the asymmetry previously described in the development of the genital cells of *Notopterophorus* is apparent and not real; the genital cells originate from four cells and not from two as previously described, but the four do not sink in at exactly the same time. The ectodermal thickening seen in parasitic Copepoda probably corresponds to a similar structure in *Neomysis vulgaris* which gives rise to the ectodermic investment of the embryo. The flattened cells which overlie the endoderm, and which were previously regarded as constituting the splanchnic layer of the mesoderm, the author now considers to be homologous with the mesenchymatous cells of Meyer in ***Psygmobranchus***.

* Arch. Biol., xvi. (1899) pp. 27–47 (1 pl.).
† Zool. Anzeig., xxii. (1899) pp. 111–14.

Annulata.

Notes on Hæmenteria.* —A. Kowalevsky has made a special study of *Hæmenteria* (*Clepsine*) *costata*, and he points out that the "unpaired gland" which H. Bolsius has described in *H. officinalis* is the heart.

He also notes that this leech is proterandrous, and that there is an exchange of spermatophores in which the male organs alone are concerned, at a period when the female organs are still rudimentary. He believes that a similar phenomenon occurs in other Hirudinea.

Ciliated Organs of Hæmenteria officinalis.† — Prof. H. Bolsius notes that in this leech the ciliated organs occur in two positions:—(*a*) beside the nerve-cord (as in *Clepsine*); and (*b*) in a lateral lacuna (as in *Nephelis*).

Sense-organs of Rhynchobdellidæ.‡—Prof. Leydig protests against the description by Herr Emil Bayer § of certain peculiar epidermal sense-organs in leeches as "new," as he himself described those in *Clepsine* in 1885 in 'Zelle und Gewebe.' Further, Prof. Leydig does not agree with all the statements made by Bayer. In *Clepsine*, when the "goblet organs" are studied in the living animal, they are seen to be surrounded by a space which is an outgrowth of the lateral blood-vessel. In this respect they are comparable to the similar structures in the skin of bony fishes. In *Aulostomum*, structures apparently related to the goblet organs occur in the epithelium of the stomach, so that these structures are not confined to the skin.

Nerve-cells of Annelids.‖—Mr. P. Calvin Mensch has a short note on the connection between the hypodermis and the ventral nerve-cord in the Syllidæ. His observations on *Autolytus* confirm those of other authors as to the difficulty of distinguishing between the nerve-cells and the cells of the hypodermis; but he finds that in *Procera ornata* and *P. tardigrada* there is a great development of mucous cells, which insinuate themselves between hypodermis and nerve-cord, and render it easy to distinguish between their respective cells. This is, however, the case only in certain regions of the body; in the head, and posteriorly where glands are absent, the two structures are indistinguishable.

The Palolo Worm, Eunice viridis Gr.¶— Prof. E. Ehlers was requested by Dr. Friedländer to investigate his "palolo" material, and as a result has come to the conclusion that the worm is *Eunice viridis* Gr., and not a species of *Lysidice*. It is specially characterised by a form of epitoky different from any hitherto described in Polychætes. An apparently complete worm measured (in spirit) 312 mm. Of this length 105 mm. constituted the broad anterior atokous region, the remainder the narrow epitokous region. The atokous region is pale coloured, the epitokous dark bluish-green or brown, the colour depending on the presence of the genital products. The epitokous region is further marked by dark brown circular spots—the ventral "eyes." The special

* Comptes Rendus, cxxviii. (1899) pp. 1185–8.
† Zool. Anzeig., xxii. (1899) p. 240. ‡ Tom. cit., pp. 97–100.
§ Zeitschr. f. wiss. Zool., lxiv. (1898). Cf. this Journal, 1898, p. 629.
‖ Zool. Anzeig., xii. (1899) pp. 164–7 (1 fig.).
¶ Nachricht. k. Ges. Wiss. Göttingen, 1898, pp. 400–15.

peculiarity of the epitokous segments lies in the fact that they do not bear modified parapodia and specialised chætæ as in other Polychætes, but owe their motility entirely to their narrow and elongated form. Again, the two forms of epitoky familiar in the Polychætes are represented on the one hand by *Nereis*, where certain of the segments become sexually mature but are not separated from the atokous segments, and on the other by the Syllidæ, where the epitokous segments separate and bud out a head. In *Eunice viridis* we have a stage intermediate between the two. It is probable that in it as in the Syllidæ the atokous segments survive the separation of the epitokous region, and possess the power of forming new segments; the free epitokous region, on the other hand, probably dies after the liberation of the genital products. It exhibits a well-marked tendency to break up into fragments. In the case of the "Heteronereis" of the Nereids the whole animal dies after the emission of the genital products.

Prof. Ehlers is not satisfied that the ventral organs of the palolo are true "eyes," but has no suggestion to make as to their function.

Swarming of the Palolo.—Dr. B. Friedländer* has a further paper on the exact cause of the appearance of the palolo worm at the surface, and on the influence of cosmic influences on the precise time of appearance. He has made an elaborate series of calculations to illustrate the dependence of other physiological phenomena on cosmic influences, as exemplified especially by the relation between birth-frequency and the state of the moon. The result is to show that the Samoan tradition that births are more frequent in the hours of rising than of falling tide has a basis of fact. A close examination of the palolo phenomena shows, however, that the swarming is not directly dependent upon the tides, or at least cannot be wholly explained by them.

Recently, Herr Svante Arrhenius † has published a paper arguing that the changes of the moon produce variations in the atmospheric electricity which have an important influence on living organisms. Without committing himself entirely to the acceptance of this position as an explanation of the appearance of the palolo, the author points out that there are many periodic organic phenomena, such as the periodicity of births, the movements of internal parasites, epileptic fits, &c., whose regularity is unexplained. To say that the appearance of the palolo is due to cosmic influences is only to say that in common with many other periodic organic phenomena its exact causation is unknown.

The remainder of the article is devoted to a reply to Krämer's ‡ paper, many of whose criticisms and observations are said to be answered by the authoritative statements of Prof. Ehlers. Friedländer believes that there can be no doubt that the true palolo is *Eunice viridis*, but the material may also contain a few headless fragments of another worm ("pseudo-palolo") which is probably a species of *Lysidice*.

Vascular and Excretory Systems of Sipunculus.§ — Herr S. J. Metalnikoff describes the "urns" of the blood in *Sipunculus nudus*, *S. tesselatus*, and *Phymosoma*. They differ in these three cases.

* Biol. Centralbl., xix. (1899) pp. 241-69.
† Skand. Arch. f. Phys., viii. (1897) p. 367. ‡ Cf. this Journal, *ante*, p. 282.
§ MT. Zool. Stat. Neapel, xiii. (1899) pp. 440-7.

The blood of *S. nudus* also shows corpuscles with hæmerythrin (usually spherical, but not constant in form) which multiply by nuclear budding. The third component elements are the leucocytes, of two sorts; and besides these there are large round transparent discs, both unicellular and multicellular. Ciliated infusorians and genital cells also occur in the blood.

The urns are seen seated inside the vessels on the walls of which they arise. It is probable, however, that they also arise elsewhere, for they are found freely in the body-cavity, with which the vascular system is not in any communication save by very minute openings between the walls of the epithelial cells. The leucocytes seem to arise in a special gland in the wall of one of the blood-vessels. The genital cells pass through three stages in the gonads at the base of the ventral retractors before they are liberated into the blood.

Metalnikoff believes that the special function of the "urns" resembles that of phagocytes, but on a larger scale. They serve to protect the organisms from hard substances (sand particles, &c.) which may get into the body-cavity if the gut be ruptured. It may also be, as Cuénot and others have suggested, that their quick movements do something to compensate for the absence of a heart. As to excretion, injected ammoniacal carmine is engulfed by the leucocytes and urns, while indigo-carmine and fuchsin are excreted by the segmental organs. It is interesting to note that in Annelids generally indigo-carmine is not got rid of by the nephridia, but by the chloragogen cells.

Forgotten Echiuroid.* — Mr. H. Lyster Jameson describes *Holothuridium papillosum*, which should be called *Thalassema papillosum* Delle Chiaje. It was discovered by Delle Chiaje, and has been twice dredged at Naples. It occupies a position nearer to *Thalassema diaphanes* than to any other known species, but seems to be quite distinct.

Rotatoria.

Structure of the Vibratile Tags in Rotifera.†—Mr. John Shephard has studied the minute structure of the flame-cells in various Rotifers, particularly in *Brachionus pala* and *Euchlanis dilatata*, and arrives at the conclusion that this organ consists of a flattened funnel, closed at one end by a protoplasmic mass, to which is attached an undulating membrane lying between two thin delicately striated walls, to which it is joined on each side for its whole length, being free only at the narrow proximal end, and dividing the interior of the tag into two separate cavities. The presence of the two long flagella on the outside of the tags in *Asplanchna amphora*, discovered by Mr. C. F. Rousselet, is confirmed. Mr. Shephard considers that the excretory fluids pass by osmosis through the thin walls of the tags.

Nematohelminthes.

Anatomy and Biology of Oxyuris curvula.‡—Herr Hermann Ehlers has studied in detail this hitherto little-known parasite. It occurs in

* MT. Zool. Stat. Neapel, xiii. (1899) pp. 433–9.
† Proc. Roy. Soc. Victoria, xi. pt. ii. (1898) pp. 130–6 (2 pls.).
‡ Arch. Naturgeschichte, lxvi. (1899) pp. 1–26 (2 pls.).

the horse, the ass, and the mule, and is not, as has been stated, entirely harmless, for infected horses are subject to periodic attacks of great restlessness and excitability. The body in the adult female consists of an anterior curved and thickened region and a posterior slender region; it varies in length from 29 mm. to 185 mm. In the much smaller male the body is rounded and slender, and the total length does not exceed 15 mm. Experiment showed that horses could be directly infected with the worm by drinking water containing embryos obtained from an adult female. The following are the most striking anatomical peculiarities. In the female the anus is at the end of the thickened region of the body, so that the thin tail does not contain any part of the gut. This tail-region, however, contains two lateral canals, which begin behind the anus and extend throughout the whole length. They are probably connected with the excretory canals, but the existence of such a connection was not proved. At the junction of the buccal cavity and œsophagus, the lining cuticle is thickened to form three projecting plates, which are fringed with a sieve of bristles. From the centre of the bristles in each plate a funnel-shaped tube projects, which close examination shows to be the orifice of one of the three œsophageal glands. In connection with the female organs there is a very curious "onion-shaped organ" of unknown significance, which connects the vagina with the exterior. The paper is illustrated by some exceedingly clear figures.

Platyhelminthes.

New Turbellarian.*—Herr H. Sabussow describes *Böhmigia maris-albi* g. et sp. n., an acœlous Turbellarian from the White Sea. Having a single genital opening, it belongs to the Proporidæ, but differs from *Proporus* in having a *bursa seminalis*, and from other genera of the family:—(1) by the absence of eye-pigment; (2) by the position of the testis in the lateral parts of the body; (3) by the absence of a *tunica propria* on the testis; (4) by the absence of *vasa deferentia*; and (5) by the simpler structure of the penis.

Development of Convoluta.†—M. Jivoin Georgevitch has studied the development in *C. roscoffensis* Graff. The eggs are usually laid in groups of five to twelve, and are surrounded by a transparent investment. The egg divides completely to produce two equal blastomeres. At the four-cell stage two upper cells (ectoderm) are distinguished from two lower larger cells (endoderm). The endoderm cells, after an interval of repose, divide laterally, giving rise to two cells which are the origin of the mesoderm. The ectoderm cells also divide, and the resulting eight cells constitute the blastula. Gastrulation is chiefly by epibole, but there is no central cavity. The central parenchyma of the adult arises from the endoderm, the peripheral from the mesoderm, which also gives rise to the muscles and genital organs. After the formation of the gastrula, the ectoderm becomes clothed with cilia, and the embryos escape from the capsule. They do not contain zoochlorellæ, and only obtain these when the surrounding water contains adults. Unless zoochlorellæ be obtained, the embryos seem to die as soon as their reserves are exhausted.

* Zool. Anzeig., xxii. (1899) pp. 189–93.
† Comptes Rendus, cxxviii. (1899) pp. 455–7.

New Cercaria from the Snail.*—Messrs. L. Vaney and A. Conte describe *Cercaria pomatia* sp. n., from the digestive gland of *Helix pomatia*. Sporocysts, cercariæ, and young flukes were found. The authors refer to two previous records of distomatous parasites in flukes, by Meckel in 1846, and Siebold in 1854.

Cestodes of Birds.†—Herr K. Wolffhügel discusses the systematic relations of *Dicranotænia*, *Drepanidotænia*, *Hymenolepis*, &c., and describes *Tænia candelabraria* and *Fimbriaria malleus*.

Incertæ Sedis.

Life-History of Dicyema.‡—Prof. W. M. Wheeler begins by giving a summary of our knowledge as to the structure and life-history of the Dicyemidæ. It will be enough to recall that the axial cell of the fully formed Dicyemid always contains germ-cells or developing embryos, a study of which has led to the distinction of two very different lines of embryonic development in individuals of the same species. In some of the individuals the germ-cells develop into so-called vermiform, in others into so-called infusoriform embryos; and although it has been shown (Whitman) that the parents of the two kinds of embryos are indistinguishable morphologically, it has, nevertheless, been found convenient to give them different names. The mother of vermiform embryos is called a *nematogen*, the mother of infusoriform embryos a *rhombogen*.

From observations on *Dicyema coluber*, Wheeler infers that the same animal is both nematogen and rhombogen at different periods of its life, and that it is first a nematogen and then a rhombogen (the reverse of Whitman's sequence). He found about a dozen specimens (out of a large number) which contained both vermiform and infusoriform embryos in process of development, indicating a transition between the two reproductive phases.

He agrees with Van Beneden in interpreting the so-called infusoriform embryo as the male Dicyemid, as is suggested by its resemblance to the male of the Orthonectidæ. The infusorigen or cell-mass which gives rise to and liberates the infusoriforms, has been regarded as an embryo (epibolic gastrula), the ectoderm cells of which are all germ-cells and give rise to the infusoriforms. "On this supposition *Dicyema* performs on its offspring an experiment which some experimental embryologist would regard as impossible, since in this case, the gastrula is resolved into its component cells, each of which is capable of reproducing a whole organism." Prof. Wheeler believes that the infusorigen may admit of a different interpretation. He finds a number of very deeply staining granules mingled with and adhering to the cells of the infusorigens. These granules closely resemble the minute bodies which were seen within the mature infusoriform, and may therefore be spermatozoa. "If this is the case, the central cell of the infusorigen may represent a chemotactic centre which facilitates fertilisation by holding all the germ-cells together in a mass and by attracting the spermatozoa to the same point in the axial cell of the *Dicyema*." On

* Zool. Anzeig., xxii. (1899) pp. 194–6 (2 figs.). † Tom. cit., pp. 217–23.
‡ Tom. cit., pp. 169–76.

this interpretation the male Dicyemids would arise from fertilised ova, and the females or nematogens from unfertilised ova.

The following life-history of *Dicyema* is suggested. Both the females (nematogens) and the males (infusiforms) may migrate from one *Octopus* to another. One or more nematogens probably enter the kidney soon after the *Octopus* is hatched, and multiply pædogenetically till the surfaces of the venous appendages are tufted with nematogens. After a time parthenogenesis languishes, the germ-cells being no longer able to produce vermiform embryos. By this time one or more males from some other *Octopus* find their way into the kidney and discharge their spermatozoa, which enter the axial cells of the nematogens and fertilise the germ-cells aggregated in the infusorigens. From these cells develop the males, which may in turn fertilise either the remaining nematogens in the same kidney, or may migrate to other Cephalopods. As in so many other cases in the animal and vegetable kingdoms, the males make their appearance when the conditions of life become unfavourable, namely, after the kidney is well peopled with Dicyemids, and food is less abundant. These unfavourable conditions are perhaps still further aggravated by changes in the renal metabolism of the *Octopus* when it is about 4 cm. long.

As to the systematic position of the Dicyemids, their mode of reproduction seems very unlike that of the flat-worms. It seems to Wheeler a step backward to place them in a separate sub-kingdom (Mesozoa), yet their structural and developmental peculiarities entitle them to a more independent rank than that of an appendix to the Platyhelminthes.

Three New Orthonectids.*—MM. Maurice Caullery and Félix Mesnil describe three new species of Orthonectids, one of which they regard as constituting the type of a new family. The first two species are referred to the genus *Rhopalura* g. n., and of them both males and females were found. One, to which the name of *R. Metchnikovi* is given, occurred in *Spio Martinensis* Mesn., the other, *R. Julini*, occurred in *Scolelepis fuliginosa*. The third form was found in *Scoloplos Mülleri* Rathke, and from thirty infested worms some hundreds of specimens were taken. All of these were uniform in appearance and apparently females, but close examination showed three testicles in each, proving that the form in question is a hermaphrodite. To this form the name of *Stœcharthrum Giardi* g. et sp. n. is given. Besides the hermaphroditism, it is characterised by the elongated body consisting of 60–70 rings. In *Rhopalura Julini* the female shows an anterior group of cells, which seems to be the rudiment of a testicle. The authors believe that the hermaphroditism of *Stœcharthrum* has been secondarily acquired by the female.

Echinoderma.

Bermuda Echinoderms.†—Mr. H. L. Clark reports on a collection of eleven species. One of the two Asteroids (*Asterias tenuispina* = *A. atlantica*) is remarkable for the great variation of its arms, which may number 4, 5, 6, 7, or 9. In regard to the species of *Stichopus*, of

* Comptes Rendus, cxxviii. (1899) pp. 457–60.
† Ann. New York Acad. Sci., xi. (1898) pp. 407–13.

which three are recognised, it is noted that specific differences cannot be recognised in this genus with any accuracy, except in living specimens, and that coloration is so variable that it is almost useless as a standard in classification. The tendency to violet colour among Bermuda echinoderms is alluded to.

Cœlentera.

Cnidosacs of Siphonophora.*—Dr. K. C. Schneider has investigated these structures in both the Physophora and the Calycophora. The latter have always an elongated form and are called Cnidosacci atorti in opposition to the coiled Cnidosacci contorti of the Physophora. In the former there is a central core of endoderm without cell limits, but with nuclei. Close to it there lies the tongue-shaped band which is derived from the endoderm. On the upper surface the cnidoblasts are arranged in a straight band consisting of seven rows of cells each containing a nematocyst. The cnidoblasts are supported by an elaborate framework of elastic fibres connected to the distal end of the tongue-shaped band. The band of cnidoblasts is covered by a thin layer of glandular cells, and at either side of it lies a band of large glandular cells.

In the Physophora the cnidosacs are spirally coiled, and the band of cnidoblasts contains more cells than in the Calycophora. In the fully developed cnidosacs there is a mere trace of an endodermic core, the endoderm being almost used up in the formation of the four tongue-shaped bands. There are also other noticeable differences from the cnidosacci of the Calycophora. The paper includes an account of the development of both types, and a summary of the observations of others. As to the discharge of the nematocysts, observation showed that this occurred only on direct contact between the cnidosacs and the prey. Contact with the terminal thread of the cnidosac, or even traction on this, did not produce discharge. Th discharge is not produced by the tongue-shaped band, is apparently not due to muscular action, and is perhaps the result of a chemical process induced by an external stimulus.

Pigment of Blue Coral.†—Prof. A. Liversidge states the results of some preliminary experiments on the blue pigment present in the blue coral (*Heliopora cœrulea*). He describes the separation of the pigment and the action of various reagents. The known blue pigments from other animals are briefly considered, and it is pointed out that the pigment from the coral differs more or less from all the rest.

Branchiocerianthus urceolus Mark.‡—Dr. Oskar Carlgren has a short note on this form which was described by Prof. E. L. Mark § as a "new type of Actinian." Carlgren believes that it does not belong to the Actinozoa at all, but is a Hydrozoan, at least closely allied to the genus *Corymorpha*, and that the so-called "gills" are in reality sexual buds. The note is based merely on Mark's "preliminary report."

* Arbeit. Zool. Inst. Univ. Wien, xi. (1899) pp. 65–116 (4 pls.).
† Journ. and Proc. Roy. Soc. N.S. Wales, xxxii. (1898) pp. 256–68.
‡ Zool. Anzeig., xxii. (1899) pp. 102–3.
§ Bull. Mus. Comp. Zool. Harvard, xxxii. (1898) pp. 145–54. Cf. this Journal, 1898, p. 633.

Edible Medusæ.* — K. Kishinouye describes two rhizostomatous medusæ, *Rhopilema esculenta* Kishinouye and *Rh. verrucosa* sp. n., which occur in Japanese waters and are used for food, and also as bait for file-fish (*Monacanthus*) and sea-breams (*Pagrus*). The latter are said to accompany the shoals of the medusæ.

Porifera.

Histology of Hexactinellidæ.†—Herr F. E. Schulze obtained, through the North German Polar Expedition of 1898, some new Hexactinellid sponges so well preserved as to make it possible to describe the choanocytes, which have not hitherto been seen in these sponges. They consist of a broad basal plate, a narrowed hourglass-shaped stalk, and a slightly conical collar from the centre of which springs the flagellum. The basal plates are fused to one another to form a continuous membrane only occasionally perforated by the pores of the chambers. The nucleus is basal, and projects only slightly above the level of the basal plate. The distal ends of the cells immediately below the collar region are united together on all sides with only occasional openings corresponding to the chamber pores. The choanocytes thus differ markedly from those described for other sponges. It is to be especially noticed that the collars of the adjacent cells show no trace of fusion, that is, there is no trace of "Sollas' membrane."

Name of Tetranthella fruticosa (O. Schm.).‡—Dr. Joh. Thiele has a short note on the correct name and the systematic position of this much-named sponge. Oscar Schmidt originally described it under the two names of *Suberites crambe* and *S. fruticosa*; but it is not a *Suberites*. The two fragments described by Schmidt belong to the same species, and according to Thiele the correct name is *Crambe crambe* (O. Schm.) and von Lendenfeld's name of *Tetranthella fruticosa* must be dropped. Further, Thiele has found that the sponge contains a few isocheles, which he believes proves that it belongs to the Desmacidonidæ. The skeleton of the sponge is described in detail.

Protozoa.

Behaviour of the Nucleus in Conjugating Infusoria.§—Herr H. Hoyer has made a detailed study of the phenomena of conjugation in *Colpidium colpoda* St. The material was fixed in a mixture of corrosive sublimate and potassium bichromate, and, after the usual treatment, was imbedded in paraffin and cut into sections. The individuals when about to conjugate attach themselves together in pairs by union of the anterior ends. Shortly afterwards the micronucleus of each enlarges, and, by a process of modified karyokinesis, divides into two. The two nuclei so formed again divide without the intervention of a resting stage. Each individual now contains four micronuclei. Of those three in each disappear, and the single remaining nucleus in each approaches the septum dividing the individuals, increases in size, and divides by a

* Zool. Jahrb. Abth. Syst., xii. (1899) pp. 205–10 (1 pl. and 1 fig.).
† SB. Akad. Wiss. Berlin, 1899, pp. 198–209 (3 figs.).
‡ Arch. Naturgeschichte, lxvi. (1899) pp. 87–94 (1 pl.).
§ Arch. f. Mikr. Anat., liv. (1899) pp. 95–134 (1 pl. and 2 figs.).

karyokinetic process similar to that seen in the preceding divisions. Of the two resulting nuclei in each cell, one is a "wandering nucleus" and migrates into the other individual; the fate of the other is not certain, but it is believed to disappear; there was no evidence of a fusion of wandering and stationary nuclei, as in *Paramœcium* according to Maupas. After the migration of the wandering nuclei, these undergo marked change of form, becoming greatly elongated, and form a spindle which is nearly as long as the body. The two nuclei formed in this way lie at the posterior ends of the bodies of the individuals. Each again divides, and with the formation of these four, nuclear conjugation is at an end and the individuals separate. During its course the macronuclei have degenerated, and a new macronucleus in each individual is formed by the union of two of its four micronuclei. The remaining two nuclei form the micronuclei of the two new individuals formed by division, while their macronuclei are formed by the division of the single macronucleus.

In a discussion of the theoretical bearing of his results, the author rejects the attempts which have been made to closely homologise the cell-organs and processes of cell-division in the Ciliata with those of the Metazoa, and states his belief that the Ciliata were a very early offshoot from the Protozoan stem. In the first divisions of the micronuclei of conjugating Ciliata he recognises clear homologies with the reducing divisions of the Metazoan egg, but he does not believe that anything corresponding to a union of sexual nuclei occurs in the Ciliata. In other words, he doubts the occurrence of the fusion of wandering and stationary nuclei in conjugating Ciliata as described by Maupas and Hertwig. He believes that the essence of the process is the introduction of a new nucleus and new cytoplasm into the exhausted individual.

Protozoan Nuclei.*—Mr. G. N. Calkins maintains that Metazoan and Protozoan nuclei cannot be strictly homologised, but it can be shown that an intermediate series of forms connect them. The nuclei of Protozoa are not all of the same type, and in some forms they may possibly be absent. The simplest structure is the distributed nucleus, consisting of isolated chromatin granules scattered about the cell. A higher type is shown by the "intermediate" nuclei, where the chromatin granules are massed together in a compact form with or without a nuclear membrane (most Euflagellates). Typical nuclei of the Metazoan type are uncommon among the Protozoa, but are occasionally found.

Nuclear differentiation in Protozoa is closely connected with an attraction-sphere or active agent in division. In nuclei of the distributed type this is an indefinite faintly staining cytoplasmic mass, in the vicinity of which the scattered chromatin granules collect previous to division, and about which they are grouped during division. In nuclei of the "intermediate" type the attraction-sphere is intranuclear, definite in form, deeply staining, and active, and chromatin granules are massed about it either permanently (*Synura*, *Chilomonas*, Euglenoids, &c.), or only during division (*Paramœba*), and with or without a nuclear membrane. In higher types of nuclei the attraction-sphere is no longer intranuclear, but this position of vantage is taken by the central spindle during

* Ann. New York Acad. Sci., xi. (1898) pp. 379-97 (1 pl.).

division (*Noctiluca* and many Metazoa). The intranuclear body of *Euglena* and other allied forms is equivalent to the attraction-sphere and not to the centrosome of the Metazoa. Chromosome-formation is first seen in the Flagellates in the form of rods which arise by the union of the previously scattered chromatin granules. They form in typical though primitive Metazoan manner in *Noctiluca* and *Euglypha*, and all Metazoa pass through these stages in preparing for mitosis.

Minute Organisms in Sea-water.*—Dr. H. H. Dixon and Dr. J. Joly carried on last summer an extensive series of tow-nettings in Dublin and Killiney Bays in the hope of finding coccoliths. They obtained not only a very large number of these, but numerous other interesting minute forms. The coccoliths were first obtained attached, along with grains of sand, to the test of a Protozoan resembling *Difflugia*; but later, by the use of a centrifugal apparatus or by straining sea-water through fine silk, they found enormous numbers of free coccoliths. Calculation showed indeed that 200 were present in 1 ccm. of a sample of water taken on a clear day. Among these a few coccospheres were present. The authors' observations on the coccoliths lead them to believe that these remarkable structures contain some organic matter between the two constituent valves. With the coccoliths occurred numbers of an apparently new Protozoan of the genus *Difflugia*, to which they give the name of *D. thalassia*. In a few cases chains of this form were found resembling the catena already known in *Ceratium tripos*. Among other interesting forms were species of *Tintinnus*, one new, numerous members of the Peridineæ, and certain peculiar new structures of spherical shape furnished with T-shaped spicules or peltate scales, to which the names of Echinosphere and Peltasphere respectively have been given. Other structures closely resembling Ehrenberg's *Xanthidia* and *Pyxidicula* were found. These were described by Ehrenberg from the chalk, and the latter, at least, were hitherto not known to be recent. They are probably encysted Protozoa. The paper is of great interest and importance.

Parasitic Infusoria in Domestic Ruminants.†—Herr Adolf Günther has made a series of observations on the Infusoria of the stomach in sheep, goats, and cattle, and on the methods of infection. He finds that the parasites are confined to the two first chambers of the stomach where the reaction is alkaline, and are speedily destroyed by the acid of the omasum and abomasum. The Infusoria can be destroyed without injury to the host by doses of hydrochloric acid administered in capsules, or less effectually by citric acid. A series of experiments showed that in lambs on milk diet the first two chambers of the stomach had an acid reaction and Infusoria were absent, while a diet of hay and water resulted in the production of an alkaline reaction and the appearance of the parasites. A diet of oil-cake and water did not result in infection. By prolonged boiling it was found that hay could be sterilised, and sheep fed with this did not show Infusoria. There is thus reason to believe that hay is the ordinary cause of infection, but infusions of hay failed to yield the characteristic parasitic forms, and the encysted stages of these are unknown.

* Sci. Proc. Roy. Dublin Soc., viii. (1898) pp. 741-52 (2 pls. and 6 figs.).
† Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 529-72 (2 pls. and 2 figs.).

The second part of the paper is devoted to the structure and cell-division of *Ophryoscolex caudatus*, a parasitic form which is very common in the sheep. Among peculiarities of structure now noticed for the first time is the presence of a peculiar supporting structure near the gullet. This is of very complex form and resistant substance. The process of cell-division is peculiar, in that the division plane is oblique and is so placed that the anterior moiety is about two-thirds of the size of the posterior. The process of division is however accompanied by an unequal elongation of the body, which is such that at the end of the process the two individuals are approximately of the same size. The elongation is accompanied by a corresponding narrowing of the body, a statement which is illustrated by copious tables of measurements. Measurements are also given of nucleus and of total body length and breadth in normal and dividing individuals.

Origin and Relationships of Foraminifera.*—The late Prof. Eimer, in conjunction with Dr. Fickert, prepared some time ago an elaborate memoir on this subject which is now published by the latter author. The paper is divided into two parts :—firstly, a general part containing a criticism of existing classifications of the Foraminifera, and an exposition of the principles which, according to Prof. Eimer, should guide the systematist; and secondly, a suggested classification of the group. The second part is due to both authors, for the first Prof. Eimer alone is responsible. As it is in essence merely a re-statement of those "laws and principles of development" with which Prof. Eimer's name is associated, we can do no more here than to refer those interested to the original memoir.

Supposed Growth of Shell in Testacea.†—Dr. E. Penard considers carefully the theory of Rhumbler that the shell of Testacea, like *Difflugia*, *Arcella*, &c., exhibits a genuine growth. According to Penard there is in such cases (Thecamœbæ) no increase after the shell is once formed.

Sporozoa in Gut of Slow-worm.‡—M. Louis Léger reports the constant occurrence of a species of *Coccidium* and a larger Gregarine (with navicular sporocysts) in the alimentary canal of *Anguis fragilis*.

* Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 599–708 (45 figs.).
† Arch. Sci. Phys. et Nat., vii. (1899) pp. 247–71.
‡ Comptes Rendus, cxxviii. (1899) p. 1128.

BOTANY.

A. GENERAL, including the Anatomy and Physiology of the Phanerogamia.

α. Anatomy.

(1) Cell-Structure and Protoplasm.

Idea of the Cell in Botany.*—Herr A. Hansen gives a critical review of the various theories with regard to the structure of the cell, especially in botany, from the time of Hooke (1667) to that of Sachs, criticising adversely the definitions of a cell and of an energid proposed by the latter authority.† Hansen proposes, for the living cell-contents, the new term *biophore*. A biophore is an independent transmitter (*Träger*) of all those forces which are included under the term vital phenomena. It consists of a protoplasm-body without nucleus, or with one or more nuclei. When enclosed in a membrane, it is termed a cell.

Phenomena of Nuclear and Cell-division.‡—Dr. B. Němec further illustrates his view as to the difference in the prophases of nuclear division between the vegetative and the reproductive tissues in the non-sexual generation of vascular plants. In the relatively free-lying cells of the sporogenous tissue the achromatic figure is multipolar, often originating radially round the nucleus; while in the vegetative tissue the achromatic figure is from the first bipolar, and forms a hyaline structure surrounding the nucleus. This bipolarity was found in representatives of almost all classes of vascular plants. In none of these plants is there any differentiated organ representing the centrosome. In all of them the primordium of the achromatic spindle makes its appearance as a hyaline structure surrounding the nucleus, forming a kind of cap at the pole, to which structure the author gives the name of *periplast*. It possesses the properties of a fluid adherent to the nuclear membrane. Its ellipsoidal or oval form in vegetative tissues must be due to the action of lateral forces. This is shown by the fact that the action of chloroform or of plasmolysis restores to this structure its original globular form. The author gives detailed reasons for not regarding this effect as pathological.

Karyokinesis in the Root-tips of Allium.—From a detailed study of the karyokinetic division of the nucleus in the root-tips of *Allium Cepa*, Dr. B. Němec § comes to the conclusion that, even in the vegetative tissue of the same species, the process may exhibit considerable variations; no general uniform scheme can be laid down for the development of the chromosomes, for their form and length, nor for the mode of separation of the longitudinal halves; but the achromatic figure always

* 'Zur Geschichte u. Kritik d. Zellenbegriffes in d. Bot.,' Giessen, 1897, 58 pp. and 1 pl. See Bot. Centralbl., lxxvii. (1899) p. 21.

† Cf. this Journal, *ante*, p. 44.

‡ Bot. Centralbl., lxxvii. (1899) pp. 241–51 (7 figs.). Cf. this Journal, 1898, p. 437.

§ Jahrb. f. wiss. Bot. (Pringsheim), xxxiii. (1899) pp. 313–36 (1 pl.). Cf. this Journal, *ante*, p. 168.

has a bipolar origin. Three types are described of the arrangement of the chromatin substance within the nucleus. The direction of the first divisions of the nucleus also varies. Centrosomes do not occur either in dividing or in resting cells.

In another paper * the same author treats of various abnormal modes of nuclear division in the same object.

(2) Other Cell-contents (including Secretions).

Cytological Changes produced in Drosera.†—Continuing her observations on the changes produced in the tentacles of *Drosera* by feeding with various food-materials, Miss Lily H. Huie states that very characteristic alterations result, both in the staining reactions and in the morphology of the cell. In five seconds, white of egg causes both the cytoplasm and the nuclear plasm to become more eosinophil, while pure amphopeptone increases their affinity for blue stains. White of egg quickly causes great impoverishment of cytoplasm and nuclear plasm, while the first effects of pure peptone are to increase their bulk and density. Both produce an enormous increase of the chromatin element of the nucleus. While the cytoplasm is the cell-constituent most rapidly and most constantly affected by external stimuli, the nucleus is the seat of metabolic activity, and the state of the nuclear structures indicates whether or not the food supply was of service to the metabolism of the plant. The results of feeding with a number of different food-materials are given in detail.

Production of Pure Chlorophyll.‡—Dr. G. Bode describes a complicated process by which he obtains pure chlorophyll or its potassium salt from green leaves. He emphasises the fact that an acid reaction of alcohol, even if only slight, decreases its power of dissolving chlorophyll, as contrasted with benzin; an alkaline reaction having an opposite effect. He points out the errors that have resulted from confusing between benzin and benzol, two substances which have nothing to do with one another, except the similarity in their names.

Red Cell-sap of Plants.§—Mr. E. Overton found that, by cultivating *Hydrocharis morsus-ranæ* in a weak solution of sugar, the leaves assume a rich reddish-brown colour, though otherwise perfectly normal. Similar results were obtained with several species of *Utricularia*, and with some land plants, as *Lilium Martagon*, *L. candidum*, *L. umbelliferum*, *Ilex aquifolium*, and *Saxifraga crassifolia*, but not with *Lemna minor* or *Potamogeton perfoliatus*.

The appearance of a red cell-sap is, in most plants, closely connected with the amount of sugar in the sap; its formation is greatly favoured by a low temperature; it is comparatively rare when the temperature is high. In the Alps it is common, even in the summer. Of leaves which become red in autumn there are two classes; one set comprises perennial leaves and those which, formed during the latter part

* SB. k. Böhm. Gesell. Wiss., 1898, 10 pp. and 1 pl.

† Quart. Journ. Micr. Sci., xlii. (1899) pp. 203–22 (1 pl.). Cf. this Journal, 1897, p. 220.

‡ Bot. Centralbl., lxxvii. (1899) pp. 81–7.

§ Jahrb. f. wiss. Bot. (Pringsheim), xxxiii. (1899) pp. 171–231; Nature, lix. (1899) p. 296.

of the summer, remain alive till the following spring or summer; the other set comprises those leaves which fall and die soon after attaining their reddish tint. The latter class of leaves, at the time when they assume their autumn tints, contain more sugar and less starch than at midsummer.

The red sap is formed either in the epiderm or in the palisade-cells, and in those which line the air-chambers of the leaf. The author believes the pigments to be probably of the nature of glucosides, in most cases compounds of tannins with sugar. In many plants they can be produced at any time of the year by feeding them with glucose.

Hydrocyanic Acid in Plants.*—M. A. Hébert finds traces of hydrocyanic acid in the red and black currant, and in *Ribes aureum* (young green shoots), embryo of *Eriobotrya japonica* (Rosaceæ), and *Aquilegia vulgaris* (leaves, stalks, and buds at the commencement of the period of vegetation); but not sufficient to constitute a means of defence.

Hydrocyanic Acid in the Amygdaleæ.†—Herr A. J. van de Ven finds the quantity of hydrocyanic acid in the branches of the cherry-laurel to decrease with increase of age. The root gave very little evidence of the presence of hydrocyanic acid. In the youngest leaves, just unfolded, the acid occurs only in isolated groups of cells along the principal veins, the proportion reaching, in the early summer, as much as 2·4 per cent. The amount of the acid in the leaves is decidedly increased by strong insolation. The author was unable to find any trace of hydrocyanic acid in *Vicia sativa* or other species of the genus, or in *Aquilegia vulgaris*, where it had been stated to exist.

Dextrin as a Reserve-substance.‡—From an examination chiefly of the bulbs of the hyacinth, M. Leclerc du Sablon ascribes to dextrin several different functions in the life of the plant, viz.:—(1) In reserve-organs in the process of formation it is an intermediate substance in the production of starch; (2) While the reserve-substances are undergoing digestion, it is a product of the decomposition of starch; (3) During the dormant period, it is a reserve-substance properly so-called independently of starch.

(3) Structure of Tissues.

Wood of Pomeæ.§—In a further instalment, Dr. A. Burgerstein contrasts the histological characters of the wood of the Pomeæ with that of the Amygdaleæ. He finds no one general character by which the two can in all cases be distinguished. In both families special characters occur in some, but are absent from other species of the same family, or even of the same genus.

"Bicollateral" Vascular Bundles.‖—According to Prof. J. Baranetzky, there are no such things as true bicollateral vascular bundles.

* Bull. Soc. Chim., xix. (1898) pp. 310–3. See Journ. Chem. Soc., 1899, Abstr., ii. p. 377.
† Arch. Néerl. Sci. Ex. et Nat., ii. (1899) pp. 383–96.
‡ Comptes Rendus, cxxviii. (1899) pp. 944–5.
§ Verhandl. k. k. Zool-bot. Ges. Wien, xlix. (1899) pp. 28–32. Cf. this Journal, 1898, p. 641.
‖ S.B. bot. Sect. Naturf.-vers. Kiew, Aug. 26, 1898. See Bot. Centralbl., lxxvii. (1899) p. 106.

Where this appearance is presented, as in the Cucurbitaceæ, it results from the apposition of two vascular bundles, of which one is often incomplete, consisting of phloem only. In some Cucurbitaceæ he found these bundles to be for a certain distance complete, containing xylem also.

Lenticels.*—Herr C. von Tubeuf criticises Wieler's conclusion that the pneumathodes on the roots of ferns are not true organs of aeration or respiration. The direct stimulus to the formation of these organs appears to lie in the moisture by which they are surrounded; their growth then proceeds without fresh stimulus, provided it is not checked by dry air; it very soon ceases if the necessary supply of moisture is not provided; but water in the liquid state is not necessary for their production or development.

Glands of Rutaceæ.†—Prof. G. Haberlandt finds, in all the species of Rutaceæ examined, and especially in *Ruta graveolens*, that the hypodermal glands are emptied by the bending of the leaf. The apparatus is composed of two constituents, the gland-lid and the gland-wall. The former is usually composed of four lid-cells which are metamorphosed epidermal cells. The separation of these cells is effected by a similar contrivance to that of the guard-cells of the young stoma. The flat usually more or less thick-walled cells of the wall of the gland exercise, by their strong turgor, a pressure on the contents of the gland, causing its sudden emptying when the leaf is bent.

Phylogeny of Ulmaceæ.‡—M. C. Houlbert has followed out in detail the development of the wood in the different genera of Ulmaceæ, especially in *Ulmus*, up to the tenth year, when it has acquired its characteristic structure, which it preserves during the rest of its existence; and points out the relationship to the Urticaceæ, Moraceæ, Boehmeriaceæ, and other allied orders.

Anatomy of Tradescantia.§—Prof. A. Gravis gives a detailed account of the minute anatomy of *Tradescantia virginica*, especially of the transitional region between stem and root. He regards the hypocotyl as the region where the root-strands join the foliar strands; there is no passage between them; but one type is substituted for the other type in the course of the hypocotyl. The so-called cauline bundles of the stem are in reality the sympodes formed by the bases of the leaf-traces.

(4) Structure of Organs.

Symmetry of the Floral Axes.‖—According to M. H. Ricome, a dorsiventral structure exists in a large number of branches of inflorescences which originate obliquely; this is shown in the form and

* Forst. Naturw. Zeitschr., 1898, pp. 405–14. See Bot. Ztg., lvii. (1899) 2te Abth., p. 56. Cf. this Journal, *ante*, p. 171.

† S.B. k. Akad. Wiss. Wien, Dec. 15, 1898. See Bot. Centralbl., lxxvii. (1899) p. 263.

‡ Rev. Gén. de Bot. (Bonnier), xi. (1899) pp. 106–19 (2 pls. and 5 figs.).

§ 'Rech. Anat. et Phys. s. l. Tradescantia virginica,' Bruxelles, 1898, 304 pp. and 27 pls. See Journ. of Bot., xxxvii. (1899) p. 228.

‖ Ann. Sci. Nat. (Bot.). vii. (1899) pp. 293–396 (4 pls. and 14 figs.). Cf. this Journal, *ante*, p. 55.

structure of the branches, in the difference of size or structure between the secondary branches or the leaves which spring from different sides of the primary branch. This dorsiventrality may be greatly modified, or even reversed, by changes in the illumination or in other external conditions. Solar radiation may produce differences between the illuminated side and the side in shade; gravity between the upper and the under side. The arrangement, number, and relative importance of the vascular bundles depend on the action of these factors. The dorsiventral structure appears to be the result of the coincidence of the illuminated side with the upper side on the one hand, and of the shaded side with the lower side on the other hand.

Relationships of the Indefinite Inflorescences.*—Mr. E. A. N. Arber traces all the various forms of indefinite inflorescence back to the solitary axillary type of flower. From this have descended, in the first place, the spike and the capitulum, according as the primary axis has continued to elongate, or has ceased to grow; then, by growth of the secondary axes, from the former the corymb and the simple and compound raceme; from the latter, the simple and compound umbel.

Fruit of Gramineæ.†—M. P. Guérin criticises unfavourably the conclusion of Jumelle ‡ that the caryopsis of grasses is simply an achene enclosing a seed without integument. He states that, in general, the ovule has two integuments, composed only of two layers of cells. The outer integument always disappears shortly after fecundation, while the inner one is persistent, and constitutes a true envelope to the ripe seed. In some cases (*Brachypodium*, *Bromus*) the epiderm of the nucellus takes part in the formation of the integument. In the pericarp the absorption is more or less complete; the endocarp usually persists in the form of long isolated cells, or of a sclerified ring. With a few exceptions there is a complete fusion between the pericarp and the integument of the seed, justifying the retention of the term caryopsis.

There are, however, some exceptional forms of fruit in the Gramineæ. In *Eleusine* and *Dactyloctenium* the fruit is a true achene, with very thin walls. This is also the structure in *Crypsis* and *Sporobolus*, where the pericarp becomes, on maturity, transformed into mucilage. In *Zizaniopsis* the pericarp is strongly sclerified, and encloses a free seed.

Seedless Grapes.§—Herr Müller-Thurgau attributes the absence of seeds in some grapes to two causes:—(1) The pollen-grains are well-developed, but the ovules are not capable of impregnation; either the pollen-tubes do not reach the ovules, or the ovule is itself sterile. To this class belong the sultanas and the currants of commerce. (2) The ovules are capable of impregnation, but the pollen-grains are degenerated; either the pollen-tubes do not germinate, or are incapable of impregnating the ovum-cell. Grapes which do not contain seeds are always smaller than those which do.

* Journ. of Bot., xxxvii. (1899) pp. 160-7.

† Bull. Soc. Bot. France, xlv. (1899) pp. 405-11; Journ. de Bot. (Morot), xii. (1898) pp. 365-74 (12 figs.); Ann. Sci. Nat. (Bot.), ix. 1899, pp. 1-59, 70 figs.

‡ Cf. this Journal, 1889, p. 663.

§ Landwirthsch. Jahrb. d. Schweiz, 1898, 71 pp. and 4 pls. See Bot. Centralbl., lxxvii. (1899) p. 135.

Anatomical Peculiarities of Oily Seeds.*—In his examination of oily seeds from the French colonies, M. E. Heckel finds, in *Pongramia glabra* (Leguminosæ), in the cotyledons, plumule, and hypocotyl, secreting pockets for the storing up of a fatty oil, readily distinguished by their deep yellow colour. In the oily endosperm of several species belonging to the Myristicaceæ and Bixaceæ he also records the occurrence of cells with reticulated bands, comparable to those existing in anthers and in the thallus of *Marchantia*. The bands form a complete network, more or less anastomosing, and completely surrounding the cell.

Law of Phyllotaxis.†—Herr L. Kny has succeeded, by removing most of the buds from a shoot of the hazel, in changing the biserial into a spiral phyllotaxis. A transition from the dorsiventral to the radiar structure, with a corresponding change in the phyllotaxis, was also observed on uninjured shoots. He concludes that the change in phyllotaxis, in the size and form of the leaf-primordia, and in the size of the apex of the shoot, must all be ascribed to the same internal causes.

Peltate Leaves.‡—M. C. de Candolle enumerates 467 species of plants (which he believes to be a nearly complete list) in which the leaves come under the general denomination of peltate, including the funnel-shaped and ascidiform leaves of the Sarraceniaceæ and Nepenthaceæ. Of these only 42 have a true central peltation. These include 18 with opposite, none with verticillate leaves; in all the rest the arrangement is "alternate." Two species of *Thalictrum* have peltate leaflets. The peltate position of the leaf-stalk is not nearly so common as might be supposed from the internal structure of the leaf.

Tubercles of the Uvularieæ.§—M. C. Queva has studied the development of the tubercles in the Uvularieæ (Liliaceæ with a rhizome or tuberous root-stock), especially in the case of *Gloriosa*. The embryo shows no trace of thickening. Neither in the axil of the cotyledon nor in that of the first foliage-leaf is there a bud. The first two leaves have very long leaf-sheaths. The hypocotyl and the first two stem-internodes are very short; the third is much longer. When five leaves have been produced, the base of the third internode swells, and buds are found in the axils of the second and third leaves; but the bud of the third leaf does not stand in the axil itself, but at the base of a canal which penetrates the whole of the third internode. The other leaves have no axillary buds. At the base of the third internode there then appear two swellings, which elongate and sink into the soil; these bear at their apices the leaf-buds of the second and third leaves, and thus the tuber is formed.

Comparative Anatomy of the Gentianaceæ.‖—M. E. Perrot enters, in great detail, into the distinguishing characteristics of the various genera of Gentianaceæ, which he divides into two sub-orders, the Gentianoideæ and the Menyanthoideæ, consisting respectively of terrestrial

* Comptes Rendus, cxxviii. (1899) pp. 945–7.

† Ber. Deutsch. Bot. Ges., xvi. (1898), Gen.-Vers.-Heft, p. 60. See Bot. Centralbl., lxxvii. (1899) p. 342.

‡ Arch. Sci. Phys. et Nat., 1899, pp. 279–80.

§ Ass. franç. p. l'avancement d. sci., Congrès, 1897. See Bot. Centralbl., lxxvii. (1899) p. 31.

‖ Ann. Sci. Nat. (Bot.), vii. (1899) pp. 105–292 (9 pls. and 28 figs.).

and of aquatic or paludose plants. To the former belong a number of saprophytic genera.

Structure of Heliamphora.*—Herr S. Krafft describes the structure of this genus of Sarraceniaceæ in relation to the root, rhizome, bracts, ascidia, assimilating leaves, inflorescence, and the peculiar glands of the genus.

Structure of Cynomorium coccineum.† — Prof. P. Baccarini and Dr. P. Cannarella describe various points in the structure and biology of *Cynomorium coccineum*, a parasite belonging to the Balanophoraceæ. No mycorhiza could be detected in the living cells.

β. Physiology.

(1) Reproduction and Embryology.

Impregnation of Lilium and Fritillaria.—Prof. S. Nawaschin ‡ has made some very remarkable observations on the mode of impregnation in *Lilium Martagon* and *Fritillaria tenella*. When the two nuclei of the pollen-tube enter the embryo-sac, they assume a cylindrical or fusiform shape, and exhibit one or two spiral coils. Although not provided with cilia, he believes them to be possessed of a power of motility. One of the two pollen-tube nuclei fuses with the oosphere or ovum-cell, while the other applies itself closely to one of the two polar nuclei which have not yet coalesced to form the secondary central nucleus of the embryo-sac. Coalescence afterwards takes place between these two and the other polar nucleus, but not until the completion of the prophasis stage of the first division. The formation of the endosperm-cells then at once commences, and it is not until eight endosperm nuclei have been produced that the fusion of the other pollen-nucleus with the oosphere takes place.

M. L. Guignard § has obtained similar results with *Lilium Martagon*. He claims for the two generative nuclei of the pollen-tube the term "antherozoid." The fusion of one of these vermiform nuclei, usually the hindermost, with the oosphere, and that of the other one with one of the polar nuclei, most commonly the upper one, takes place as described by Nawaschin; but the union of one of the male nuclei with one of the polar nuclei of the embryo-sac is not regarded by Guignard as a true process of impregnation; he terms it an act of "pseudo-fecundation." These observations appear to point to a still further connecting link between the mode of impregnation in the higher Cryptogams and that in Angiosperms.

Miss Ethel Sargant ‖ confirms the main points of Nawaschin and Guignard's observations in the case of *Lilium Martagon*.

Oogenesis in Pinus Laricio.¶—Prof. C. J. Chamberlain's observations on the fertilisation and embryology of *Pinus Laricio* confirm in

* 'Beitr. z. Kenntn. d. Sarraceniaceen-Gattung Heliamphora,' München, 1898, 31 pp. and 21 figs. See Bot. Centralbl., lxxvii. (1899) p. 414.

† Atti R. Accad. Lincei, viii. (1899) pp. 317–20.

‡ Bull. Acad. Imp. Sci. St. Petersbourg, ix. (1898) No. 4. See Bot. Centralbl., lxxvii. (1899) p. 241.

§ Rev. Gén. de Bot. (Bonnier), xi. (1899) pp. 129–35 (1 pl.).

‖ Proc. Roy. Soc., lxv. (1899) pp. 163–5 (1 fig.).

¶ Bot. Gazette, xxvii. (1899) pp. 268–80 (1 pl.).

essential points those of V. H. Blackman on *P. sylvestris*.* The following is given as a summary of the most important results. While the ventral canal-cell usually disappears soon after it is formed, in some cases it persists, and its nucleus becomes as large as that of the oosphere, passing through a similar developmental history. In the development of the oosphere nucleus, the chromatin takes the form of nucleoles, which finally collect from all parts of the nucleus to a definite area near the centre, and there develop into a typical spirem. The linin often stains like chromatin. After the male pronucleus has entered the oosphere nucleus, the chromatin of the two pronuclei appears as two distinct masses in the spirem stage. Although centrosomes were not positively identified, appearances favour the supposition that they may accompany the male nuclei. The fate of the spindle indicates that the kinoplasmic fibres arise through a transformation of the cytoplasmic reticulum.

Embryology and Fertilisation of Alnus.†—Prof. S. Nawaschin states that, in the mode of formation of the ovule, *Alnus viridis* resembles *Corylus* and *Carpinus*, two or three embryo-sacs being developed. The ovules are nearly orthotropous. The pollen-tube descends along almost the whole length of the integument in order to reach the chalaza.

Embryo-sac of Sparganium and Lysichiton.‡—In the species of *Sparganium* examined (chiefly *S. simplex*), Prof. D. H. Campbell finds a remarkable increase in the number of antipodal cells after impregnation. This may reach as high as 150, by far the largest number yet recorded in any plant. If impregnation does not take place, they remain small in size and few in number. The nearest approach to this phenomenon known elsewhere is in Gramineæ; and the author regards these facts as conclusive evidence that the antipodals are something more than rudimentary survivals of a prothallium.

In *Lysichiton*, belonging to the Araceæ, the antipodals are of unusual size after fertilisation, but the number never exceeds ten. Their nuclei reach enormous proportions. The character of the antipodals is quite different from that in any other described Angiosperm, most nearly approaching that in some Compositæ.

Development of the Pollen-grain and Embryo-sac in Bignonia.§—Mr. B. M. Duggar records the following among other points in the case of *Bignonia venusta*. Before the flower-bud opens, median transverse and longitudinal sections of the anther show the pollen-mother-cells occupying four boat-shaped layers, each layer a single cell in depth. In the microsporanges, both divisions of the pollen-mother-cells are complete before there is any differentiation in the megasporange of the primitive archespore; no tapete is cut off. The embryo-sac develops by the immediate growth of the fourth or lowest megaspore in the axial row. In the development of the microsporange or pollen-grain, the definitive archespore is differentiated at a very early period. No indication of a true spirem is seen until after synapsis. In the first division, the spindle is truly multipolar.

* Cf. this Journal, 1898, p. 644.

† S.B. Bot. Sect. Naturf.-vers. Kiew, Aug. 26, 1898. See Bot. Centralbl., lxxvii. (1899) p. 106.

‡ Bot. Gazette, xxvii. (1899) pp. 153–66 (1 pl.).

§ Bull. Torrey Bot. Club, xxvi. (1899) pp. 89–105 (3 pls.).

Embryology of the Rubiaceæ.*—In the genera *Rubia*, *Houstonia*, *Sherardia*, *Vaillantia*, *Crucianella*, and *Galium*, Mr. F. E. Lloyd finds that in the hypoderm of the nucellus 8 or 10 megaspores develop; many of these germinate, becoming quadrinucleate; one, or sometimes two, become perfect embryo-sacs with antipodals. One of the antipodals is very large, filling up the whole lower half of the embryo-sac in *Sherardia*, *Rubia*, and *Galium*. The suspensor is divided into two regions, micropylar and embryonal. The latter is composed of disc-shaped cells; the former of large cells swollen out laterally, forming absorbing organs which become applied to the endosperm.

Fertilisation of Viola.†—Mr. T. Meehan suggests that in some species of *Viola*—*V. cucullata* and *tricolor*—the pollen-tubes must reach the ovules in some other way than through the stigma and style. *V. cucullata* flowers at a period of the year when there are very few winged insects, and the membranous appendages to the anthers are so closely adpressed to the style as to render it almost impossible for the pollen-grains to reach the stigma. And yet the great majority of the flowers produce capsules with fertile seeds. The same is also the case with *V. tricolor*. Mr. Meehan regards the so-called stigmatic opening at the apex of the thickened style as a nectariferous gland.

Biology of Pollen.‡—Herr B. Lidforss adduces further evidence in favour of his contention that moisture is not generally destructive of the germinating power of pollen-grains, and criticises adversely the method pursued by Hansgirg.§ This power of resistance of pollen to moisture is often greatly influenced by external conditions; it is greatly enhanced in moist air. The connection between the exposure of the pollen and its power of resisting moisture is traced out in a large number of cases. As a rule, those pollen-grains which are unable to resist moisture germinate very rapidly.

The pollen-grains of anemophilous plants are, as a rule, characterised by their comparatively small size. While containing a larger proportion of starch, they have less nitrogenous matter than those of entomophilous plants.

Sex in Flowers.‖—Mr. T. Meehan adduces the American *Corylus rostrata* as an additional example of the law previously enunciated by him, that, in the earliest stages of its life, the sex of a flower-bud is not determined, and that its final development as a male or female flower is the result mainly of differences in the supply of nutrition.

(2) Nutrition and Growth (including Germination, and Movements of Fluids).

Nutrition of Plants by Nitrogenous Substances.¶—A series of experiments by M. L. Lutz on the feeding of plants by various organic nitrogenous substances has led to the following results. It is possible

* Bot. Gazette, xxvii. (1899) pp. 120-1.
† Proc. Acad. Nat. Sci. Philadelphia, 1899, pp. 92-5.
‡ Jahrb. f. wiss. Bot. (Pringsheim), xxxiii. (1899) pp. 232-312. Cf. this Journal, 1896, p. 437.
§ Cf. this Journal, 1898, p. 319.
‖ Proc. Acad. Nat. Sci. Philadelphia, 1899, pp. 84-6.
¶ Ann. Sci. Nat. (Bot.), vii. (1899) pp. 1-103.

for flowering plants placed in aseptic conditions to take the nitrogen necessary for their sustenance from organic compounds belonging to the class of amines in the form of salts. The assimilation of these substances may take place without their nitrogen having been first transformed into nitric or ammoniacal nitrogen. Ammoniacal salts composed of alkaloids cannot supply to plants their necessary nitrogen. Algæ placed in similar aseptic conditions present the same phenomena as flowering plants. Fungi have the power also of deriving their nitrogen from amines as well as from nitric or ammoniacal nitrogen. With them, in regard both to amines and to alkaloids, the assimilation is in inverse proportion to the size of the molecules.

Influence of Electricity on Plants.*—From a series of experiments carried on on a very large number of plants, Mr. G. E. Stone states that electricity exerts an appreciable influence on their growth; the application of certain strengths of current for a short time (one minute or less) is sufficient to act as a stimulus. Germination and growth are both accelerated by electricity. Electrically stimulated plants do not respond immediately, but possess a latent period of about 25 minutes; the excitation produced by alternating currents is more marked than that produced by direct currents.

Herbaceous and Woody Grafts.†—M. L. Daniel distinguishes two stages in the anatomical processes which take place in grafting,—the preliminary and the definitive stage; the former lasting up to the moment when the functions of the inner and outer generating layers, interrupted by the operation, are resumed. The definitive stage may again be divided into two periods:—the formation of the cellular tissues which fill up the vacancies caused by the wound; and the differentiation of the vessels and sieve-tubes in the healing tissues produced by the activity of the inner generating layer, and the formation of bark and phelloderm.

Causes of the Direction of the Lateral Branches of Trees.‡—According to Prof. J. Baranetzky, the development of the lateral branches of trees presents two different types. In one (maple, ash, chestnut, &c.) the physiological properties of the lateral branches are the same as those of the erect main stem, their oblique direction being due to the angle at which they branch from the main stem. In others (lime, elm, &c.) the lateral branches are physiologically bilateral even in the bud. In pines, all the first year's shoots are erect. The subsequent bending down of the lateral branches is due to the unequal growth of the tracheids.

Downward Growth of Rhizomes.§—Herr A. Rimbach attributes the power of rhizomes or other underground forms of stem to rise or to sink gradually deeper into the soil to changes in the direction of the

* Bot. Gazette, xxvii. (1899) pp. 123–4.

† 'Rech. anat. s. l. greffes herbacées et ligneuses,' Rennes, 1896, 104 pp. and 3 pls. See Bonnier's Rev. Gén. de Bot., xi. (1899) p. 78.

‡ S.B. Bot. Sect. Naturf.-vers. Kiew, Aug. 28, 1898. See Bot. Centralbl., lxxvii. (1899) p. 108.

§ Beitr. z. wissensch. Bot., iii. Abth. 1, 1898, pp. 117–204. See Bot. Centralbl., lxxvii. (1899) p. 25.

growth in length, due to the curtailment or elongation of the internodes of the stem, rarely (*Colchicum*) to the lateral extension of the underground organ itself. It is influenced by the depth of covering of soil; a slight covering inducing descent, a thick covering ascent. The phenomenon cannot be explained by heliotropism or aerotropism.

Germination and Parasitism of Ximenia.—M. E. Heckel * has noticed a peculiarity in the germination of the seeds of *Ximenia americana*, belonging to the Olacaceæ. On the hypocotyl are produced five scales, preceding the true leaves; of these the lowermost pair penetrate, in the manner of roots, into the trough formed by the petioles of the cotyledons, and become united with the tissue of the cotyledons at the base of their laminæ. The author suggests that they may possibly act as organs of absorption.

In a second communication,† M. Heckel states that the roots put out suckers, each root or branch of a root ending in a sucker, and that by means of these organs a parasitic attachment is secured to a root or stem; this attachment taking place to a stem of the same species where no other is available. This parasitic character seems to indicate an affinity between the Olacaceæ and the Santalaceæ.

Germination of Neottia Nidus-avis.‡—M. N. Bernard believes the presence of a mycorhiza to be necessary to the germination of seeds of the bird's-nest orchis. This mycorhiza attacks all the moist parts of the plant, even the ripe seed-vessels, and the seeds will germinate while still enclosed within the fruit. The moist rhizomes and other underground parts are especially infested by the mycorhiza, which may be absent from the dry parts above the surface.

(3) Irritability.

Irritation-Movements in Biophytum.—Dr. G. Haberlandt § records the results of some experiments on the irritation-movements in the leaves of *Biophytum sensitivum*, and the transmission of the irritation; the most important being the repetition of the reaction-movement in response to a single irritation. From the phenomena of the reaction he concludes that the irritation is conducted through the parenchyme of the vascular bundles by means of protoplasmic connections from cell to cell.

Prof. D. T. McDougal ‖ points out the discrepancy between these observations and his own.¶

(4) Chemical Changes (including Respiration and Fermentation).

Primary Synthesis of Proteids in Plants.**—Mr. W. M. Kozlowski discusses this subject at considerable length from a chemical point of view. He considers a large part, if not all, of the oxalic acid produced in plants to be a final product of decomposition of proteids, and in a certain degree, to be analogous to carbamide in animals; it appears to be always an excretory product. There is a strong analogy between

* Bull. Soc. Bot. France, xlv. (1899) pp. 438–41.
† Comptes Rendus, cxxviii. (1899) pp. 1352–3. ‡ Tom. cit., pp. 1253–5.
§ Ann. Jard. Bot. Buitenzorg, Supp. ii. 1898, pp. 33–8.
‖ Bot. Centralbl., lxxvii. (1899) pp. 297–8.
¶ Cf. this Journal, 1897, p. 143.
** Bull. Torrey Bot. Club, xxvi. (1899) pp. 35–57.

the production of cellulose in plants and that of fat in animals. The cellulose and the carbohydrates consumed by respiration, combined with amides, produce new proteids.

Transformation of Carbohydrates.* — Herr F. Schüller classifies semi-fruticose and perennial herbaceous plants under five types, according to the variations in the amount of starch and reducing sugars which they contain at different periods of the year. Some of them, e.g. most of the Ericaceæ, display the same phenomenon in this respect as "oil-trees," while many others behave in quite a different way.

Influence of Carbohydrates on the Formation of Proteids.†—From experiments carried on by Herr E. Schulze, it would appear that seedlings which had been grown for two weeks or more in the dark showed that the loss of proteids was least the greater the amount of non-nitrogenous matter present. In the changes which these substances undergo in the seedlings, soluble carbohydrates are formed from insoluble substances, a portion being converted into glucose. The glucose promotes the regeneration of proteids from asparagin, glutamin, and perhaps other products of the decomposition of protein. Regeneration of protein is greatest in the case of seeds which contain the largest quantity of non-nitrogenous reserve-substances, but the decomposition of proteids is not checked by the presence of non-nitrogenous compounds.

γ. General.

Protection of Plants against Fungi.‡—Dr. Th. Bokorny enumerates the various organic substances which serve to protect plants against the attacks of Fungi and Schizomycetes. The most widely distributed of these are tannins; but more than 1 per cent. of tannin is necessary to give the parts of living plants immunity against the attacks of Fungi or bacteria (spring oak-bark contains 4–20, tea-leaves 12–15 per cent. of tannin). Bacteria offer less resistance to tannin than mould-fungi. Salts of oxalic acid are not poisonous to the lower fungi, while any free acid is injurious to the growth of all fungi; oxalic not more so than malic or tartaric acid. Essential oils afford an effective protection against the attacks of all parasitic organisms.

Effect of Parasitic Fungi on Plants.§—Prof. B. D. Halsted notes the fact that one species of parasitic fungi frequently developes in the host-plant immunity from another species. In the autumn colouring of the sugar-maple he has observed that the green or yellow blotches are invariably accompanied by the maple-mildew, *Uncinaria circinata*.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Folded Tissue in Isoetes.‖ — M. O. Lignier describes a case of "folded tissue" in the ligule of *Isoetes*, on the basal face of the foot. It

* 'Ueb. d. Umwandlung d. Kohlehydrate in d. Halbsträuchern u. perennirenden Kräutern,' Leipzig, 1898. See Bot. Ztg., lvii. (1899) 2te Abth., p. 68.

† Landwirth. Jahrb., xxvii. pp. 516–20. See Journ. Chem. Soc., 1899, Abstr. ii. p. 322.

‡ Biol. Centralbl., xix. (1899) pp. 177–85.

§ Bull. Torrey Bot. Club, xxvii. (1899) pp. 12–20 (2 figs.).

‖ Bull. Soc. Linn. Normandie, ix. (1895) p. 42. See Bonnier's Rev. Gén. de Bot., xi. (1899) p. 31.

is readily distinguished from the tissue of the ligule proper by the small size of the cells filled with protoplasm. The position of this tissue, between the conducting xylem and the ligular tissue, indicates that it is intended for the rapid passage of fluids. Its purpose appears to be similar to that of the endoderm of roots, combining firmness with great permeability.

Apogamy and Development of Sporanges on Fern Prothallia.*—Mr. W. H. Lang gives the results of experiments carried on for two-and-a-half years in the cultivation, under slightly abnormal conditions, of the prothallia of a number of ferns, chiefly cultivated varieties. In all cases the prothallia which would, under normal conditions, have produced normal embryos, became apogamous after a longer or shorter period. The conditions which produce this result appear to be prevention of contact with water, and exposure to direct sunlight. The degree of apogamic variation presented great variety. The author regards these departures from the normal development of the thallus, not as reversions in the ordinary sense, but as indications of the capability of direct response to altered conditions possessed by the gametophyte; showing that the sporophyte and the gametophyte are modifications of a similar form. Originating from algal organisms of a flattened form, prolonged drought and the influence of direct sunlight might induce directly a change of form into a cylindrical body, accompanied by the substitution of a reproductive organ forming dry reproductive cells, or spores for those adapted to an aquatic existence. From these spores separated from the parent, a sexual individual would arise, since germination could take place only in a damp spot; and thus an alternation of sexual and non-sexual generations might be brought about.

Muscineæ.

Classification of Leucobryaceæ.†—M. J. Cardot proposes a new classification of the Leucobryaceæ, founded chiefly on the anatomical characters of the leaf. The Leucophaneæ, comprising the single genus *Leucophanes*, are first of all separated off, from the presence of a sclerified bundle in the mid-vein; the remainder of the order being divided into the tribes Leucobryeæ, Octoblephareæ, and Arthrocormeæ. M. Cardot reckons 176 species in the Leucobryaceæ, arranged in nine genera, of which two are new, *Cardotia*, separated from *Leucobryum*, and *Exodictyon*, distinguished by the peculiar form of the mid-vein, which is often papillose.

Nanomitrium.‡—Mr. E. S. Salmon gives an account of this genus of Musci, hitherto regarded as cleistocarpous. The capsule (in *N. tenerum*) possesses a distinct zone of specialised cells, delicate, narrow, and transversely elongated, clearly marking off the upper part of the capsule as a lid. Similar rows of cells were found in *N. synoicum* and *Austini*, but not in *N. æquinoctiale*, which is truly cleistocarpous. The capsule possesses stomates, and shows a similar structure in all essential points to that of *Ephemerum*. The zone of differentiated cells by which a

* Phil. Trans. R.S., cxc. (1898) pp. 187–238 (5 pls.). Cf. this Journal, 1897, p. 223.
† Rev. Bryol., xxvi. (1899) pp. 1–7 (1 pl.).
‡ Journ. Linn. Soc. (Bot.), xxxiv. (1899) pp. 163–70 (1 pl.).

regular dehiscence is effected, alone separates *Nanomitrium* from *Ephemerum*; the author placing both genera in the Funariaceæ.

Fructification of Ephemeropsis tjibodensis.*—Herr M. Fleischer has met with the hitherto unknown capsule of this rare Javanese moss, which determines it to belong to the series of the Hookeriaceæ, rather than of the Ephemeraceæ. It is usually diœcious. The very remarkable persistent protoneme forms a dense felt on Phanerogams and ferns, to which it is fixed by peculiar organs of attachment. This structure branches copiously in a dichotomous manner into dorsiventral filaments, and produces gemmæ.

New Genera of Mosses.—Among Giraldi's collection of mosses from China, the late C. Müller † describes no less than 112 new species, and the following new genus belonging to the Entodontaceæ.

Giraldiella g. n. Cespites robusti, brachytheciacei; caulis decumbens, ramis brevibus turgescentibus lepyrodontoideis divisus; folia robusta entodontoidea, binervia, cellulis alaribus multis parenchymatibus ornata; theca entodontoidea, robusta; calyptra dimidiata, albula; peristomium duplex, robustum, longum; dentes externi anguste lanceolato-subulati, articulati, cristati, hypnoidei; interni in membrana reticulata longi in lacinias angustissimas impellucidas binas v. parum flexuosas carnosas fissi.

From S. Africa the same author ‡ describes a new genus of Syrrhopodontaceæ, *Hypodontium*, with the following diagnosis:—Plantæ altæ, robustæ, cespites densos v. compactos sed laxe coherentes sistentes, parce dichotomæ divisæ, folia dense imbricata, plus minusve circinato-crispatula et involutacea, basi vaginacea, crassinervia, firma; peristomium simplex externum; dentes 16, lati-lanceolati, integri, v. apice fissiles, interdum furcati, firmi, suberrimi, robuste articulati, glabri, profunde infra orificium thecæ firmæ ellipticæ v. pomiformis oriundi; calyptra dimidiata, inflorescentia dioica.

From Japan M. E. Bescherelle § describes the following new genus of pleurocarpous mosses.

Pilotrichopsis g. n. Rami penduli, semipedales et ultra, graciles, laxe et remote pinnati, ramulis apice attenuatis stoloniformibus patentibus plerumque simplicibus divisi; folia appressa, ovato-lanceolata, subplicata, unicostata, basi exauriculata, cellulis ovalibus inferioribus ad margines oblique quadratis; perichætia ad ramos et ramulos producta.

New Fossil Moss.‖—Under the name *Rhynchostegium Knowltoni*, Mrs. Elizabeth G. Britton describes a fossil moss from the Lower Miocene or Upper Eocene strata in Washington Territory, U.S.A.

Tubers in the Hepaticæ.¶—Mr. M. A. Howe describes the occurrence of "tubers" in 11 species of Hepaticæ, viz. 4 of *Anthoceros*, 3 of *Riccia*, 2 of *Petalophyllum*, 1 of *Fossombronia*, and 1 of *Geothallus*. In *Anthoceros phymatodes*, from California, the "tuber" first appears as a swelling near the apparent apex of a costa-like thickening of a thallus

* Hedwigia, xxxviii. (1899) Beih., pp. 8–10 (1 fig.).
† Nuov. Giorn. Bot. Ital., 1898, p. 158. ‡ Hedwigia, xxxviii. (1899) p. 96.
§ Journ. de Bot. (Morot), xiii. (1899) p. 38.
‖ Bull. Torrey Bot. Club, xxvi. (1899) pp. 79–81 (1 fig.).
¶ Bot. Gazette, xxvii. (1899) pp. 122–3.

segment, becoming later strictly ventral through the continued outward growth of the segment, and at the same time pendent from the ventral surface through the formation of a peduncle. The body of the "tuber" consists of a cortex of 2–4 layers of nearly empty cells, enclosing a mass of smaller cells densely filled with oil-drops or colourless granules. They are probably reserves of food-material, and assist in the vegetative propagation of the plant.

Sporogone of Anthoceros.*—Herr V. Lühne discusses the homology of the sporogone of *Anthoceros* with the sorus of ferns. The following are the chief points of resemblance of the Anthoceroteæ and the Hymenophyllaceæ:—(1) The germination of the spores, and the development of the prothallium of the latter and protoneme of the former, closely resemble one another; (2) The sporogone of *Anthoceros* and the sorus of *Hymenophyllum* each possesses a central sterile receptacle or columel; (3) Both organs exhibit intercalary growth; (4) The sporogenous portion of the sporogone of *Anthoceros* is surrounded by a wall which detaches itself in the form of two valves, and which may be compared to the 2-valved indusium of *Hymenophyllum*; (5) the sporogenous cells of *Anthoceros* and the sporange of *Hymenophyllum* both develop basipetally. The most important differences between the two have been held to be these:—(1) The sporogenous layer of the sporogone of *Anthoceros* belongs to the wall of the capsule; while the sporanges of the Hymenophyllaceæ have their origin in the superficial layers of the receptacle; (2) The sporogenous cells of *Anthoceros* are directly isolated; while the sporanges of the Hymenophyllaceæ develop from the receptacle as multicellular structures, developing the spore-mother-cells within them.

Lühne now confirms the close relationship of the two families by showing that the sporogenous layer of the capsule of *Anthoceros* belongs in reality to the columel. He also suggests that the analogues of the sporange of the Hymenophyllaceæ is to be met with in the spore-mother-cells of *Anthoceros* surrounded by elaters.

Characeæ.

Development of the Oogone in the Characeæ.†—Herr G. Goetz states that in *Nitella* (*flexilis*) the oogone originates in place of a lateral leaflet; a cell of the node swells out and divides into three superposed cells. The lowermost of these forms the stalk-cell, the middle one the node-cell, and the uppermost finally develops into the true ovum-cell. In *Chara* (*fœtida*), the oogone developes from the upper cell of the antheridial basal node, and again likewise divides into a stalk-cell, a node-cell, and an apical cell; from the latter are developed the ovum-cell and the single *Wendungszelle*. In *Nitella*, after the formation of the three *Wendungszellen*, the ovum-nucleus continues to excrete nuclear substance, which passes into the germinal spot. In *Chara* nothing of this kind takes place. In the formation of the *Wendungszellen* there is no reduction of chromosomes. The fusion of the sperm-

* S.B. Deutsch. Naturw.-med. Ver. Lotos, 1898, No. 1. See Bot. Centralbl., lxxvii. (1899) p. 164.

† Bot. Ztg., lvii. (1899) 2te Abth., pp. 1–13 (1 pl. and 3 figs.).

nucleus and ovum-nucleus is completed at the base of the ovum-cell. After impregnation the ovum-nucleus travels to the germinal spot. In the Characeæ nuclear division takes place karyokinetically in all meristematic cells, directly only in the cells of the mature enveloping tubes and internodes. Centrosomes were nowhere seen.

As to the systematic position of the Characeæ, Goetz adopts Cohn's view, separating them from the Algæ, and constituting them into a distinct class which he calls PHYCOBRYA, having its nearest affinity with Mosses.

Algæ.

Regeneration in Algæ.*—Herr E. de Wildeman describes the mode of regeneration of dead growing points by the proliferation of adjoining cells through the dead terminal cell, in *Cephaleuros* and *Trentepohlia*, comparing it with the so-called false branching of the Schizophyceæ; also the renewal of the thallus of *Phycopeltis* from the marginal cells and from the adjoining cells of old portions of the thallus. He concludes that all the cells of filiform algæ are capable, after injury or death of adjoining cells, of producing new cells by division, to regenerate the destroyed portions of the thallus.

Pyrenoids.†—Investigations by Prof. Chmjelewsky on the cultivation of *Hyalotheca* lead him to the conclusion that, in this case, the pyrenoids are not of the nature of a reserve-deposit of proteids, but are independent organs of the cell, the function of which is at present unknown.

Life-History and Cytology of the Fucaceæ.‡—Continuing their examination of various species and genera of Fucaceæ, Prof. J. B. Farmer and Mr. J. Ll. Williams state that, in the development of the oogones, the first papilla possesses the same number of chromosomes as the rest of the somatic cells; but that, after the stalk is septated off, and during the first division of the nucleus of the oogone itself, the number has been reduced by one-half. The nuclear divisions are associated with the presence of centrospheres, in which centrosome-like structures can sometimes be seen. In the expulsion of the oospheres from the oogone a considerable part is played by mucilage. In the normal process of impregnation only a single antherozoid enters the oosphere. Groups of antherozoids are attracted to the unfertilised oospheres; while, after impregnation has been effected, a definite repulsion of the antherozoids is seen. When the fertilised oosphere undergoes segmentation, the nucleus possesses twice as many chromosomes as there were in the oogonial mitoses, and this double number is retained throughout the life of the plant, except in those divisions which lead directly to the production of sexual cells.

Abnormal Conjugation in Spirogyra.§—Herr Schmula describes an abnormal mode of conjugation in *Spirogyra nitida*, in which one cell

* Mém. courron. Acad. r. de Belgique, lviii. (1899) 19 pp. See Hedwigia, xxxviii. (1899) Beibl., p. 85.

† S.B. Bot. Sect. Naturf.-vers. Kiew, Aug. 28, 1898. See Bot. Centralbl., lxxvii. (1899) p. 108.

‡ Phil. Trans. R.S., cxc. (1898) pp. 623–45 (6 pls.) Cf. this Journal, 1896, p. 656.

§ Hedwigia, xxxviii. (1899) Beibl., pp. 1–3 (2 figs.).

of the male filament has formed an imperfect connection with two in the female, or one in the female with two in the male filament, the passage of the protoplasm taking place through one connecting tube only.

Chlorosaccus, a New Genus of Fresh-water Algæ.* — Under the name *Chlorosaccus fluidus* g. et sp. n., Herr A. Luther describes a fresh-water alga, which he makes the type of a new genus, forming, with *Vacuolaria*, a family VACUOLARIACEÆ, intermediate between the Chloromonadales and the Confervales. The following is the diagnosis of the genus.

Cellulæ vegetativæ in coloniis gelatinosis peripherice dispositæ, membrana tenui; chromatophori 2–plures, parietales, disciformes, luteo-virides, pyrenoidibus et amylo destituti; nucleus centralis unicus. Divisione simultanea longitudinali cellulæ filiales quaternæ decussatim dispositæ oriuntur. Multiplicatio agamica zoosporis e cellulis vegetativis immutatis ortis, monostromaticis, ciliis binis, uno longiore porrecto, altero breviore, plerumque averso, germinantibus thallum thallo materno similem formantibus. Cellulæ perdurantes akinetæ sunt.

Ophiocytium.† —Herr E. Lemmermann gives a conspectus of the 20 species of this genus of Algæ, three of them new, in which *Sciadium* is sunk. He ranks it as the sole member of a distinct family of Confervaceæ, OPHIOCYTIACEÆ, with the following characters:—Algæ unicellulares, multis nucleis præditæ; chlorophora plura, parietalia, sæpe literæ H ad instar formatæ, epyrenoidea. The diagnosis of the genus is as follows:—Cellulæ libere viventes v. in plantis aquaticis sedentes, cylindricæ v. claviformes, uno polo plerumque capitato-inflatæ, rectæ, arcuatæ, litteræ S ad instar curvatæ v. spiraliter contortæ, singulæ v. in familiis simpliciter umbellatim dispositis, v. corymboso-ramosis consociatæ, utrinque rotundatæ, truncatæ v. mucronatæ, v. uno polo rotundatæ, altero stipite basi incrassato v. spina instructæ; chlorophora plura, parietalia, sæpe litteræ H ad instar formatæ, epyrenoidea; contentus cellarum globulis oleaginosis hyalinis v. flavo-fuscescentibus interdum præditæ. Propagatio fit aplanosporis v. zoogonidiis ovoideo-oblongis, biciliatis.

Ulvella americana sp. n.‡—Julia W. Snow describes a fresh-water alga found in an aquarium near Ann Arbor, Mich., U.S., as a new species of this hitherto marine genus. It has a flat disk-shaped thallus, and is propagated by zoospores and by vegetative division. Though resembling *Coleochæte* in appearance, it is of a much lower type of structure. It reverts easily to a unicellular condition.

Coccospheres and Rhabdospheres.§ — Messrs. G. Murray and V. H. Blackman give further details of the structure of these deep-sea organisms. The new family COCCOSPHÆRACEÆ is defined as consisting of free unicellular algæ, provided with an outer covering of calcareous plates, free from, overlapping, or readily separable from each other;

* Bih. k. Svensk. Vet.-akad. Handl., xxiv. (1899) 22 pp. and 1 pl.
† Hedwigia, xxxviii. (1899) pp. 20–38 (2 pls. and 4 figs.).
‡ Bot. Gazette, xxvi. (1899) pp. 309–14 (1 pl.).
§ Phil. Trans. R.S., cxc. (1898) pp. 427–41 (2 pls.). Cf. this Journal, 1897, p. 318.

the plates are characterised by symmetrical excrescences or markings. The following are the diagnoses of the two genera:—

Coccosphæra. Spherical; plates consisting each of an outer and an inner expanded limb joined by a central collar, numerous, circular or oval, and overlapping, perforate, striate radially on the outer face; with a single central green chromatophore; reproduction by fission.

Rhabdosphæra. Globular to oval; plates round or angular, perforate, free from, or apposed to each other, bearing projections from the centre of the outer surface.

The new species described are *Coccosphæra leptopora*, *Rhabdosphæra tubifer*, and *R. claviger*.

Fungi.

Formation of Conids in Fungi.*—Herr C. Werner distinguishes, in *Nectria cinnabarina*, three different kinds of conid:—aquatic conids, which may be abstricted in an irregular way from all the hyphæ; aerial conids, formed on simple or branched erect conidiophores; and those formed on branched crowded hyphæ, often in a strongly developed stroma; their form is always narrowly elliptic. The first kind are formed in fluid media; the second on nutrient agar or gelatin; the third kind are produced when the substratum is drier than the surrounding air. The formation of conids decreases with the increase in concentration of the medium. In *Volutella ciliata*, abundance of nutriment and a low transpiration lead to the formation of tufts of conidiophores; if the nutriment is deficient and transpiration low, simple conidiophores are produced.

Influence of Light on the Development of Fungi.†—From a series of experiments made chiefly on *Pilobolus microsporus* and *Coprinus stercorarius*, Herr F. Graewitz finds that the ripening of the sporanges, which normally takes place only at night, is not necessarily dependent on an entire absence of light. On the other hand, the sporanges of *Pilobolus* and the pileus of *Coprinus* are not differentiated in perpetual darkness. The rapidity of the development of the receptacle increases with the intensity of the light.

Parasitic Fungi.—Prof. G. Lagerheim ‡ records the occurrence of two new species of parasitic fungus:—*Empusa phalangicida* sp. n. on a Phalangid, the only species yet discovered parasitic on other animals than insects; and *Iola Lasioboli* sp. n., parasitic on *Lasiobolus equinus*, growing on cow-dung, the first known example of a basidiomycete parasitic on a discomycete; also of *Physoderma* (*Urophlyctis*) *leproides*, parasitic on the lucerne in Ecuador.

Herr O. Juel § enumerates the various æcidia found on different species of Umbelliferæ, and connects them with their teleutospore forms. These are found also on Umbelliferæ (usually on a different species from

* 'Die Beding. d. Conidien-bild. b. einigen Pilzen,' Frankfurt-a-M., 1898, 48 pp. and 55 figs. See Bot. Ztg., lvii. (1899) 2te Abth., p. 99.

† 'Ueb. d. Einfluss d. Lichtes a. d. Entwick. einiger Pilze,' Leipzig, 1898, 74 pp. See Bot. Ztg., lvii. (1899) 2te Abth., p. 97.

‡ Bih. k. Svensk. Vetens.-Akad. Handl., xxiv. Ad. 3, No. 4, 1898, 22 pp. and 3 pls. See Hedwigia, xxxviii. (1899) Beih., p. 94.

§ Ofv. k. Vetensk. Akad. Förh., lvi. (1899) pp. 5-20 (4 figs.) (German).

the æcidio-form), or (in the case of *Æ. Angelicæ*) also on species of *Polygonum*.

Mr. D. Griffiths * has studied the structure and development of *Ampelomyces Quisqualis*, which is parasitic on a variety of other fungi, themselves growing on a number of different host-plants.

Under the name *Colletotrichum Violæ-tricoloris* sp. n., Mr. Ralph E. Smith † describes a new parasitic fungus very destructive to the leaves and petals of the cultivated pansy.

Mr. D. M. Duggar ‡ describes in detail the injuries to the sugar-beet caused by three parasitic fungi, *Rhizoctonia Betæ*, *Cercospora beticola*, and *Oospora scabies*.

A parasitic fungus exceedingly destructive to *Coronilla montana* in Germany is described by Herr P. Magnus § as *Helminthosporium Bornmülleri* sp. n.

Amylocarpus encephaloides ‖—Herr G. Lindau describes the structure and development of this little-known fungus, distinguished by the power of iodine to impart a blue colour to its spores. He places the genus in the Pyrenomycetes and in the Perisporiaceæ, using the term in its wider sense. The special family in which it should be placed is the Plectascineæ, but it differs from all the other genera in the absence of conidiophores, in the thick firm peridium, and in the form of the asci and spores.

Reproductive Forms of the "Black-Rot."¶—M. J. Perraud states that *Guignardia Bidwellii*, the fungus which causes the "black-rot" of the vine, may maintain its vitality through the winter in the three following forms:—as stylospores developed from pycnids in the autumn; as pycnids preserved intact; and as sclerotes or peritheces.

Monilia variabilis sp. n.**—Herr P. Lindner finds, on white bread moistened with dilute beer-wort, a remarkably polymorphic fungus, to which he gives this name. It forms white mealy flakes composed of long nearly cylindrical usually empty cells with small projections, on which are seated torula-like conids. The form assumed by the fungus is influenced to an extraordinary degree by the nature of the medium and the conditions of growth.

Biology of Agaricus velutipes.††—Mr. R. H. Biffen has studied, under cultivation, the biology of *Agaricus* (*Collybia*) *velutipes*. From the minute sclerotes one or two sporophores are formed directly, and from these again are produced one or more generations of sporophores. The great reduction in the size of the sclerotes appears to be correlated with this mode of propagation. The laminæ of the sporophore are exposed from the first, the only approach to the formation of a "velum partiale" being afforded by the hairs of the recurved margin of the pileus pointing

* Bull. Torrey Bot. Club. xxvi. (1899) pp. 184-8 (1 pl.).
† Bot. Gazette, xxvii. (1899) pp. 203-4 (1 fig.).
‡ Cornell Univ. Exp. Stat., No. 163, pp. 339-63 (many figs.).
§ Hedwigia, xxxviii. (1899) Beibl., pp. 73-4 (1 pl.).
‖ Tom. cit., pp. 1-19 (2 pls.).
¶ Comptes Rendus, cxxviii. (1899) pp. 1249-51.
** Wochenschr. f. Brauerei, 1898 (1 fig.). See Bot. Centralbl., lxxvii. (1899) p. 67.
†† Journ. Linn. Soc. (Bot.), xxxiv. (1899) pp. 147-62 (3 pls.).

towards the stipe. It is thus completely gymnocarpic. A "conducting system" was found, running through the stipe and lower portion of the pileus into the laminæ.

A Plankton-Fungus.*—In plankton-gatherings from the neighbourhood of Plön and elsewhere, Dr. O. Zacharias finds abundance of an organism readily mistaken for the diatom *Atheya Zachariasi*, but in reality a fungus, which has been identified as *Cucurbitaria aqueductum.*

Marine Microscopic Vegetable Organisms.†—Mr. W. H. Harris describes a group of marine microscopic vegetable organisms which he finds attached to the calcareous remains of Foraminifera in dredgings from various parts of the world; they occur also in calcareous spicules and particles of Polyzoa, and in the spines of Echinoderms. Sometimes the superficial layers of one or both sides of the shell are alone infested; in others they penetrate to a considerable depth, or may actually perforate the shell. They are referred to the genera *Lacuna* and *Achlya.*

Ray Fungi.‡—Ray fungi, says Herr V. Lachner-Sándoval, have always been classed among the bacteria, and the true branching exhibited by them has been erroneously described as pseudodichotomy. According to the author, these fungi consist of a simple or ramified unicellular mycele, and multiply by acrogenous separation of conid chains or by filament fragments. Ray fungi therefore are not bacteria, but Hyphomycetes. All known species of ray fungi are placed by the author in the genus *Actinomyces* In all 29 species are alluded to and their synonyms given. Some of these species have hitherto been placed in *Streptothrix* and *Cladothrix*, others in *Oospora*, *Nocardia*, *Bacillus*, or *Discomyces*. Special cultures were made with *Actinomyces albidoflavus* Gasp., for the details of which research the original should be consulted.

Parasitic Fungus in Cancer.§—M. J. Chevalier isolated a parasite from cultures of cancerous tumours, primary and secondary carcinomatous and sarcomatous, from the blood of cancer patients, and from the air of cancer wards. The cultures were made in a bouillon of cow's udder containing 2 per thousand of sodium chloride. Subcultures were made from the deposit in the bouillon, in glucose-bouillon, agar, serum, gelatin, potato, and cabbage. The optimum reaction was faintly alkaline, and the optimum temperature 28°–35°. In bouillon the predominant forms were spores and conids, on cabbage a mycele with or without spores. In old cultures of any medium the two forms were found together. In the fluid cultures there is a red colour when the spores are forming. The conid or cylindrical cell measures 6 μ by 2 μ. From this is developed a mycele and eventually endogenous conids. The spores are about 1 μ in diameter, ruby red, and surrounded by a gelatinous material. The best stains were Kühne's blue, gentian-violet, Poirier's blue, and safranin. Cultures inoculated on animals (guinea-pigs, rabbits, and dogs) gave rise to local and metastatic tumours which sometimes exhibited the appearances of sarcoma and sometimes of carcinoma.

* Biol. Centralbl., xix. (1899) pp. 285–6.
† Journ. Quekett Micr. Club, vii. (1899) pp. 138–61 (2 pls.).
‡ Strassburg, 1898, 8vo, 75 pp., 1 pl. See Hedwigia, xxxviii. (1899) Beibl., p. (29).
§ Comptes Rendus, cxxviii. (1899) pp. 1293–6.

A report on the toxins of the organism is promised later.

A comparison of this organism with a cancer parasite described by Dr. Bra * has proved the identity of the two microbes, and has substantiated the claim of Dr. Bra to priority of publication.

Oospora Form (Streptothrix) of the Microsporum of the Horse.†—M. E. Bodin, who recently demonstrated that the *Microsporum* of the horse presents two cultural forms, the euconidium and the acladium, and that it was possible to interchange these two forms, has discovered a third phase derived from the acladium form, and brought into existence by slow and interrupted drying. This third form of *Microsporum* belongs morphologically to the genus *Oospora*, while from its size, from the details of its structure, and its cultural characters, it is clearly connected with that little group of *Oospora* formerly known as *Streptothrix* of which *Actinomyces* is the type. To this oospora-form of *Microsporum* a twofold interest attaches; for firstly, it shows that the oosporæ of the streptothrix group are Mucedineæ; and secondly, it establishes a bond of relationship between the parasites of actinomycosis, madura foot, bovine-glanders, and the pseudo-tuberculosis of Eppinger on the one hand, and ringworm fungi on the other. Even apart from the foregoing considerations, the fact of the pleomorphism is worth attention.

Mycetozoa.

Biology of the Myxomycetes.‡—Herr C. Lippert thus describes the development of the sporange from the plasmode in *Physarum cinereum*, which occupies a period of about 48 hours. The formation of the capillitium commences almost immediately after that of the sporange, in the form of bladders composed of granules of lime; these anastomose with one another so as to form a network of cavities, which gradually increases in size. At first the wall of this bladder is composed of particles of lime only; after about two hours it is seen to be enclosed in a delicate hyaline membrane, and this network is the first origin of the capillitium. At the same time minute refringent granules make their appearance in the protoplasm of the sporange, which subsequently increase in number, and are the nucleoles of the future spores. The spores are formed, about 20 hours later, by an accumulation of protoplasm around these particles.

The process is similar in *Didymium microcarpum* and *Chondrioderma difforme.*

Protophyta.

a. Schizophyceæ.

Classification of Schizophyceæ.§—In Engler and Prantl's 'Natürliche Pflanzenfamilien,' Herr O. Kirchner classifies the Schizophyceæ as follows:—

* Comptes Rendus, cxxviii. (1899) pp. 1480–1.

† Tom. cit., pp. 1466–7.

‡ Verhandl. k.-k. zool.-bot. Ges. Wien, xlvi. (1896) 8 pp., 1 pl. and 9 figs. See Bot. Centralbl., lxxvii. (1899) p. 199.

§ Engler u. Prantl, Die natürl. Pflanzenfam., Lief. 177, 1te Abth., Leipzig, 1898, 48 pp. and 15 figs.

Coccogoneæ.
  Chroococcaceæ.
  Chamæsiphonaceæ.
Hormogonieæ.
  Psilonemateæ.
    Oscillatoriaceæ.
    Nostocaceæ.
    Scytonemaceæ.
    Stigonemaceæ.
  Trichophoreæ.
    Rivulariaceæ.
    Camptotrichaceæ.

The artificial separation of the Hormogonieæ into Homocysteæ and Heterocysteæ is abandoned. In the Psilonemateæ—distinguished from the Trichophoreæ by the absence of the terminal hair—the first character used in differentiating the genera is the occurrence or not of branching in the filaments. *Plectonema* is therefore placed among the Scytonemaceæ, *Isocystis* and *Microchæte* among the Nostocaceæ. The Chamæsiphonaceæ are placed among the Coccogoneæ because of their unicellular structure up to the time of the formation of the conids.

β. Schizomycetes.

New Genus of Bacteria.*—Mr. A. V. Jennings describes a genus of bacteria (*Astrobacter*) found in stagnant water in the neighbourhood of Tübingen by Mr. Coppen Jones. The specimens described were observed in preparations of *Spirillum undula* stained to show the cilia. The appearances depicted in the illustrations show rod, Y-shaped, and stellate forms, the latter having 4–8 rays.

Decline and Regeneration of Spore-formation in Bacteria.†—Herr W. Migula states that it has been borne in upon him that the principal cause of the decline in spore-formation lies less in nutritive and environmental conditions, than in peculiar individual characters connected with the laws of inheritance. Hence the more any race or stock of any bacterium betrays an inclination to the vegetative form, the more this tendency will develop by continued cultivation; and, *per contra*, the more such stocks or races incline to spore-production, the more probable is it that future sub-cultivations will exhibit the tendency to a freer and more constant development of spores. In order to test experimentally the accuracy of this hypothesis, the author selected a sample of anthrax with poor spore formation. A four weeks old culture on potato, which showed only a few isolated spores, was exposed for a quarter of an hour to a temperature of 90° C., to destroy the vegetative cells. Transfers were made on agar, and from these colonies potato was inoculated. This procedure was repeated several times, and in the end an anthrax culture was obtained in which each individual cell contained a spore.

Method for Determining the Specific Gravity of Bacteria.‡—Herr Almvist has determined the specific gravity of bacteria by centrifuging

* Proc. Roy. Irish Acad., v. (1899) pp. 312–6 (2 pls.).
† Zeitschr. f. angew. Mikroskopie, v. (1899) pp. 1–3.
‡ Zeitschr. f. Hygiene u. Infekts., xxviii. (1898) pp. 321–30. See Centralbl. Bakt. u. Par., xxv. (1899) p. 619.

suspensions. A lactocrite with a steam turbine which made 8000 revolutions a minute was used. In the sediment the different constituents of the culture were deposited according to their weight, the spores being at the bottom and the rodlets at the top. The most suitable emulsion or suspension fluid was found to be iodide of soda. When cultures of hay bacillus were centrifuged in this fluid with a specific gravity of 1·3, a sediment was deposited; but when the specific gravity was 1·4 there was no deposit. Hence most of the spores had a specific gravity of between 1·35 and 1·4.

Chemical Action of Pathogenic Micro-organisms.*—MM. L. Hugounenq and M. Doyon have observed the ferment action of pathogenic microbes by cultivating in sterilised glucose solutions containing nutrient materials placed in contact with excess of calcium carbonate and maintained at 35° for a definite length of time. *Staphylococcus aureus* produces small quantities of alcohol and inactive lactic acid, the gases evolved being hydrogen and carbonic acid. *Bacillus coli communis* produces inactive and dextro-lactic acids, ethylic alcohol, and a volatile acid not identified. From anaerobic cultures hydrogen and carbonic acid were evolved. A similar result was obtained from tetanus; but with Eberth's bacillus the gases were nitrogen and carbonic acid. Under favourable conditions Eberth's bacillus and *B. coli com.* decompose alkaline nitrates in $1\frac{1}{2}$ per cent. solutions, setting free nitrogen and the corresponding alkali and utilising oxygen.

Biliverdin added to a nutrient solution containing *Staphylococcus aureus*, septic vibrio, cholera bacillus, Eberth's bacillus, or *B. coli com.*, is decomposed with the formation of a red colouring matter. Bilirubin under the same conditions gives similar results. The red colouring matter is soluble in water, and its solution is dichroic. Hæmoglobin is converted into hæmatin by these organisms.

Necessity of Free Oxygen to Essential Anaerobes.†—Prof. W. Beijerinck states his belief in the necessity of free oxygen for all known living organisms; and, instead of essential and potential aerobes and anaerobes, he would use the terms aerophilous and microaerophilous. All bacteria save spirilla, the greater number of potential anaerobes, the majority of infusoria, and probably all the cells of animals and of the higher plants, are aerophilous. The microraerophilous are some essential anaerobes to which belong the *Chromatiums*, the sulphur bacteria, and *Spirillum desulfuricans*; probably also the lactic ferments, some species of monads, and some infusoria.

As far as their development is concerned, the greater part of the true spirilla and probably also some monads are aerophilous, but are microaerophilous for movement. Thus the consumption of oxygen is merely one of degree, and free oxygen a necessity to even essential anaerobes. In order to explain away the phenomena of essential and potential anaerobiosis, the existence of reserve oxygen in the cell itself is assumed.

* Ann. Chim. Phys., vii. (1898) pp. 145–56. See Journ. Chem. Soc., 1899, Abstr. ii. pp. 376–7.
† Arch. Néerland. Sci. exact. et nat., ii. (1899) pp. 397–411.

Influence of Soil Microbes on Vegetation.*—M. E. Gain has investigated the properties of alinite, with a view to ascertain if its application produced a marked increase in the weight of plants under experimental conditions, and if so, whether this favourable influence exists to any useful degree under ordinary conditions of cultivation. Alinite is a dry yellowish powder which contains the spores of *Bacillus Ellenbachensis* α, now regarded as identical with *B. megaterium* de Bary. This microbe has the power not only of fixing free nitrogen, but of dissolving out nitrogen from organic matter. Moreover, the pentoses form a food-stuff extremely favourable to its development.

Though the number of experiments is too scanty to make a decidedly definite statement, the results obtained by the author under experimental conditions, that is to say, under favourable conditions of soil, temperature, humidity, and attention, gave sufficient encouragement to pursue the research under practical agricultural conditions. The experiments were made with buckwheat and flax. The conclusions arrived at were that alinite does exert a useful action, and that this is shown by the greater development of the plants and by a more abundant grain production.

Chemical and Bacteriological Examination of Soils.†—Dr. A. C. Houston's report deals with the chemical and bacteriological examination of soils with reference to the amount and nature of the organic matter, and the number and character of the bacteria contained in them. The intention of the inquiry was to examine *pari passu* chemically and bacteriologically the washings from surface soils, and more particularly those soils suspected of being in dangerous proximity to water supplies. The results of bacteriological examination appear to have been more successful in demonstrating the existence of pollution than the chemical. The report contains the results of numerous experiments and descriptions of many organisms.

Sugar Bacterium.‡—Profs. H. M. Ward and J. R. Green report exhaustively on a sugar bacterium derived originally from excrescences on Madagascar sugar-canes, these clumps being produced by the symbiotic action of the bacillus with a yeast. The organisms were separated and isolated on sugar-gelatin. On plates the colonies of the bacterium were dome-shaped, watery-looking, and stiff enough to be lifted on the needle. The colony, in fact, is a zooglœa mass composed of short rodlets in pairs or chains, the cell-walls of which are so swollen as to furnish the zooglœa jelly. The average size of the rodlets is 2–3 μ by 1 μ. The organism appears to grow equally well in the presence or absence of air, but refuses to grow in or on any pabulum devoid of sugar. The best results were obtained with cane-sugar, either in a purified or in a raw condition. In 10 per cent. saccharin and yeast extract at 16°–31° C., the liquid became opalescent and viscous in two or three days, typical gelatinous zooglœa being deposited. The viscosity is thought to depend on the deliquescence of the swollen cell-walls. Special experiments determined that the bacterium produced acetic and succinic acids and carbonic dioxide. The immediate antecedent of the acetic acid appears

* Rev. Gén. de Bot. (Bonnier), xi. (1899) pp. 18–28.
† Rep. Local Govt. Board, 1897–8, pp. 250–307 (13 figs.).
‡ Proc. Roy. Soc., lxv. (1899) pp. 65–84.

to be fructose. The bacterium was found to secrete invertase. Though the exact nature of the gelatinous matrix was not determined, reasons are given for concluding that it is really nothing more than the swollen cell-walls or sheaths investing the bacteria. These sheaths are probably composed of dextran, and their development appears to be favoured by the presence of calcium chloride.

Thames Bacteria.* — Prof. H. M. Ward devotes a third article to bacteria isolated from Thames water. Eighteen forms are described, and these, though belonging to the same type, are separated into two groups, the Proteus and the yellow Proteus, according as they are pigmented or not.

Some of the biological phenomena described are interesting. Thus in form No. 51 plates were found to become rapidly liquefied towards the end of the second day. This phenomenon was found to be due to the fact that the surface of the plate was covered with a bacterial film, one cell thick, so thin that its existence could only be determined by the aid of a lens. This invisible film in fact formed the real margin or corona of the colony, and its existence affords sufficient explanation of the apparently sudden liquefaction. The arrangement of the bacteria in the films much resembles, as depicted in the illustration, finger-print impressions. The outgrowth from the margins of the films is described as closely resembling pseudopodia of Amœbæ. The growth and method of formation of the pseudopodia were observed by making an impression culture on a cover-glass smeared with gelatin. The gelatin-layer was dabbed on one of the creeping-films of a two days' old culture, then fixed in a culture cell, and observed as a hanging drop.

In the second group, that of the yellow Proteus type, seven types are described. The general features which they possess in common are that they form thin cloudy colonies on plates composed of coarse and fine radiating and much interlaced filaments. They liquefy gelatin more or less rapidly. The individual rodlet varies from 1–2 μ to 4–6 μ in length, and from 0·5 μ–0·75 μ in breadth. They are quiescent or only slightly motile. With age the cultures become more or less pronouncedly yellow. On agar and potato the yellow colour is also observed, but there is no growth above 25°. Milk is acidified but not peptonised.

Thermal Death-point of Tubercle Bacilli.† — Dr. Th. Smith thus summarises his experiments with regard to the thermal death-point of tubercle bacilli in heated fluids. Tubercle bacilli, when suspended in distilled water, normal salt solution, bouillon, and milk, are destroyed at 60° C. in 15 to 20 minutes. The larger number are destroyed in 5 to 10 minutes. When tubercle bacilli are suspended in milk, the pellicle which forms during the exposure of the fluid to a temperature of 60° C. may contain bacilli after 60 minutes.

Organism of the Root-tubercles of the Alder.‡—According to Herr L. Hiltner, the organism of the root-tubercles of *Alnus* and of the Elæagnaceæ—the *Schinzia Alni* of Woronin, *Frankia subtilis* of Brunchorst—is

* Ann. of Bot., xiii. (1899) pp. 197–251 (3 pls.). Cf. this Journal, 1897, p. 426.
† Journ. exper. Med., iv. (1899) pp. 217–33.
‡ Forstl. naturw. Zeitschr., vii. (1898) pp. 415 *et seq.* See Amer. Nat., xxxiii. (1899) p. 450.

not a true fungus, but forms, with those which produce the root-tubercles of the Leguminosæ, a distinct group of Schizomycetes, forming a connecting link with the Fungi, and characterised by the formation of sporanges. The organism enters the host-plant through the root-hairs. Inside each hair is a mucilaginous thread in which the organisms lie imbedded. Before reaching the root itself, this mucilaginous mass becomes filamentous, and resembles mycelial threads. Within the root the masses of mucilage resemble plasmodes, which extend from cell to cell, and ultimately become of a spongy consistency, from the appearance of numerous vacuoles surrounded by thin walls of mucilage, in which lie the organisms, now more or less in the form of filaments. Very soon after the formation of a tubercle, these organisms change into spheres filled with nitrogenous matter which rapidly develops into spores; in other words, they become sporanges. The spores germinate rapidly, forming short rods which fill the cells of the tubercle, but do not develop mucilage.

Mosaic Disease of the Tobacco Plant.—Herr D. Iwanowski* states that Beijerinck's views on the mosaic disease of the tobacco plant are erroneous, inasmuch as two distinct diseases have been confused and one has been made a phase of the other. The mosaic and pock diseases, though not infrequently met with in the same plant, often occur separately; and while the mosaic is an infectious malady, the pock is not. By artificially inducing rapid transpiration, the pock disease may be imparted to healthy plants in a few days. Seven years ago the writer filtered the juice of plants infected with mosaic disease, and found that the filtrate retained its infective property for months. He had also observed that infected leaves, even when kept in 95 per cent. alcohol, retained their infective power for 10 months. Recently the author has obtained some evidence to show that the disorder is bacterial, but he merely states that some cultivations gave positive results when inoculated on healthy plants.

Prof. W. Beijerinck † concedes Herr D. Iwanowski's claim to priority in using the porcelain filter to obtain a germ-free juice expressed from infected tobacco leaves. The writer defends his position as to the pock disease and some other details.

New Acid-resisting Bacillus.‡—Dr. O. Korn describes a bacillus which has much resemblance to the tubercle bacillus on the one hand, and to the pseudo-tubercle bacilli (butter, timothy grass, and dung bacilli) on the other. Like the bacilli of Petri and Rabinowitsch, the original source of the new organism was butter, and it was obtained through the intermediation of a guinea-pig. The deposits much resembled those of tuberculosis, that is to say, there were caseous masses in different parts and organs, notably in the lymphatic glands. The organism was readily cultivable in the ordinary media at room as well as at incubation temperature. There were morphological differences according to the media, the shape varying from that of *B. coli communis* to a *Coccothrix* form. The bacillus was easily stainable, even by Gram's method, but

* Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 250–4 (2 figs.).
† Tom. cit., pp. 310–11.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 532–41.

was less resistant to acid than the tubercle bacillus. Unlike the tubercle bacillus, the new pseudo-tubercle bacillus developed well at room temperature in gelatin thrust-cultures. Though the original source appears to have been a guinea-pig infected with butter, pure cultures failed to produce any pathogenic effect in guinea-pigs, rabbits, fowls, or pigeons. White mice, however, were susceptible when intraperitoneally injected.

Peptonising Diplococcus.*—Dr. W. G. MacCallum and Dr. T. W. Hastings give a detailed description of *Micrococcus zymogenes*, which was isolated from a case of ulcerative endocarditis.† It is a small somewhat elongated diplococcus, occurring sometimes in chains of four, though usually in pairs. It is easily stained by the usual anilin pigments and by Gram's method. It was cultivated in the ordinary media with success. Milk was acidified and coagulated, the clot being soon peptonised. The milk then assumed a purplish or yellowish colour, and still later a blood-red hue; this reaction was constant. Blood-serum and gelatin were liquefied. *M. zymogenes* is a potential anaerobe, and is killed in five minutes at 60°–65°. Laboratory animals succumb to inoculation with pure cultures. The most interesting experiment was on a dog whose aortic valve had been intentionally damaged and the animal intravenously infected. The animal was killed after a few days, and on the damaged valve vegetations were found, and also extension-deposits on the mitral valve. From these vegetations *M. zymogenes* was isolated.

Presence of Frisch's Bacillus in the Nasal Mucosa.‡—Dr. A. De Simoni is convinced of the not infrequent occurrence of capsule bacilli in the nasal mucosa of man and animals, and from studying the biological and morphological characters of these bacteria has been forced to the conclusion that they are all varieties of a single species, of which the pneumobacillus is the chief representative; the extreme examples being found in Frisch's bacillus (*Rhinoscleroma*) and *Bacillus mucosus*. The material examined was taken from cases of acute and chronic nasal catarrh, and from the nasal secretion of rabbits, guinea-pigs, and dogs. Frisch's bacillus was isolated nine times out of 76 examinations.

Bacillus enteritidis sporogenes.§—Dr. E. Klein reports on the morphology and biology of *B. enteritidis sporogenes*, its association with infantile diarrhœa and cholera nostras, and on its relations with milk, sewage, and manure. The microbe was first detected on the occasion of an outbreak of diarrhœa amongst the patients of St. Bartholomew's Hospital in October 1895. The organism is easily cultivated under anaerobic conditions in milk, in which it forms gas and acid. It is $1 \cdot 6$–$4 \cdot 8\ \mu$ in length and $0 \cdot 8\ \mu$ in breadth. Spores $1 \cdot 6 \times 1$–$1 \cdot 2\ \mu$ are formed with great freedom, and usually towards the end of the rodlet. The cultivated spores are resistant to drying, and to a temperature of 100° C. for one minute, while those obtained from the intestine will stand 110° C. for 6 to even 10 minutes. The spores are easily cultivated in milk and on blood-serum. The microbe grows well on agar to which 2 per cent. of grape-sugar has been added, and also on grape-sugar-gelatin,

* Johns Hopkins Hospital Bull., x. (1899) pp. 46–7.
† See this Journal, *ante*, p. 320.
‡ Centralbl. Bakt. u. Par., 1[te] Abt., xxv. (1899) pp. 625–31.
§ Rep. Local Govt. Board, 1897–8, pp. 210–50 (11 pls.).

which is usually liquefied. If, however, much gas is at first produced, there is little or no liquefaction and no spore-formation. Two curious differences in the behaviour of the microbe to milk are described; in the one case the spores produce the typical change in milk, the whey of which contains non-sporing and virulent bacilli; in the other case, atypical milk cultures are produced, and these contain sporing and non-virulent bacilli. Virulent cultures are pathogenic to rodents. The author then passes in review the characters of certain other anaerobes, and compares them with *B. enteritidis sporogenes*. *B. enteritidis sporogenes* has been detected in the stools and intestinal contents of cases of infantile diarrhœa and of cholera nostras, in samples of milk obtained from different sources, in sewage, and in manure.

Streptococcus scarlatinæ.* — Dr. Klein and Mr. M. Gordon, in a report on the microbes associated with scarlet fever, allude to *Streptococcus conglomeratus* Kurth, and claim that it is identical with the *Streptococcus scarlatinæ* isolated by Klein from the blood of acute cases of scarlatina, and from the ulcers on the udders of cows. Both organisms produce in broth cultures a nebulous whitish-grey mass of cocci threads which is deposited as sediment, the rest of the fluid remaining clear. Both cause rapid coagulation of milk, and a broth culture of both when injected subcutaneously into mice produces septicæmic infection and death. Observations made on later stages of the disease and during convalescence proved the not infrequent existence of *Str. scarlatinæ* in the throat.

The method for detecting its presence is as follows:—A swab from the throat is stirred up in salt solution, and some of the latter rubbed over the surface of an agar plate, which is then incubated at 37° for 24–48 hours. The colonies are small round translucent growths from which subcultures are made in alkaline broth. In 24–48 hours the characteristic appearance is presented. Subcultures in milk and incubated at 37° effect coagulation in 1–3 days. Litmus-milk is turned red.

Bacilli granulosi.†—Herr Mühlschlegel describes three bacilli isolated from corn which were characterised by the presence of marked granulation and the formation of spores. The chief interest in these three microbes, *B. granulosus immobilis* α and β, and *B. granulosus mobilis*, lay in the formation of the granules, which was found to occur both early and regularly in young cultures, and could hardly therefore be a degenerative phenomenon. Numerous observations and experiments were made to determine the exact nature of these granules, and eventually a causative relation between the appearance of the spores and the disappearance of the spherules lying in their immediate neighbourhood was established. These spherules do not appear to be identical with the granules found in pathogenic bacteria. They exhibit a spore-like character; they exist in large numbers and in various sizes in the three bacilli examined, and impart to them a wave-like appearance. Their formation proceeds independently of spore-formation. The spherules become free along with the spores, and retain their shape for some time. The spherules do not germinate.

* Rep. Local Govt. Board, 1897–8, pp. 326–31 (6 figs.).

† Arb. a. d. k. Gesundheitsamte, xv. pp. 131–52. See Centralbl. f. Bakt. u. Par., 1te Abt., xxv. (1899) p. 771.

Growth of the Typhoid Bacillus in Soil.*—Dr. S. Martin's report on the growth of the typhoid bacillus in the soil deals with the growth of the bacillus in soils of diverse character, and with the viability of the bacillus under differing conditions of temperature, as affected by drying and by the presence of other bacilli in the soil.

The general conclusions are that the soils which are favourable to the growth of the typhoid bacillus are those which have been cultivated, more particularly soils of gardens and the entourage of houses. In these soils the bacillus was found to be alive and to have retained its vegetative properties for 456 days.

Certain soils, when sterilised, independently of the quantity of water which they contain, are absolutely inimical to the growth of the typhoid bacillus. These were all virgin soils, sandy or peaty. There is no evidence to show what property of these soils it is which kills the bacillus.

In favourable soils in a moist condition the bacillus not only grew at a temperature of 37°, but even at much lower temperatures (as low as 3° C.). The viability of the bacillus in the presence of other and competing organisms was found to present, at any rate for the present, great difficulties, which are however expected not to be insuperable.

Bacillus of Distemper (Febris catarrhalis epizootica canum).†—Dr. Jess isolated from the nasal discharge of dogs suffering from distemper a bacillus 1·8–2·3 μ long and 0·6–0·9 μ broad. The bacillus was also found in the blood and internal viscera, and in the conjunctival secretion. It is easily stained by the usual anilin dyes and also by Gram's method. The bacillus from the nose or eye exhibits polar staining with phenol-fuchsin, but when cultivated in bouillon the whole rodlet is stained. In pure cultures the bacilli are single and separate, while in the body chains as long as 11 μ are met with. Though the original stock was isolated in Petri's capsules by incubating for 24 hours at 37°, characteristic colonies were obtained on gelatin at room temperature (15°–16° R.) in 3 days. The colonies are whetstone-shaped. The organism was also cultivated on agar, blood-serum, and potato. In hanging drops lively movements are visible. A single flagellum at one pole was demonstrated by means of Loeffler's method. Infection of pure cultures produced fever, loss of appetite, discharge from nose and eyes, diarrhœa with bloody stools, and even sudden death after 3 days. The incubation period of the experimental disease was 3–4 days.

* Rep. Local Govt. Board, 1897–8, pp. 308–17.
† Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 541–6 (1 pl. and 3 figs.).

MICROSCOPY.

[The Publication Committee of the Journal has decided on resuming the issue of the Microscopic Bibliography, which was dropped on the lamented death of Mr. John Mayall, jun. It is intended in future to give at least the title of every work or paper (commencing from January 1st, 1899) coming under the head of Microscopy A or of Technique 3 (Microtomes); and we shall be much obliged to any of our Fellows who will call our attention to any such papers or articles published in Journals which are likely to escape our notice.—EDITOR.]

A. Instruments, Accessories, &c.*

(1) Stands.

Reichert's New Polarising Microscope.—The stand (numbered 1 in catalogue) is large model (fig. 97), and is fitted with a square vulcanite plated stage, 100 × 100 mm. The body rotates about the optical axis, the coarse adjustment is by rack-and-pinion, and the fine with new delicate micrometer screw. Abbe's illuminating apparatus and iris diaphragm are supplied; the mirrors are plane and concave; and the instrument is adjustable in all positions. The polarising apparatus is after Ebner and Drasch, and is easily affixed to the stage, the divided circle being just as easily applied to the rim of the upper joint. The polarising apparatus is also easily removed, so that the instrument is available for ordinary histological and bacteriological work as well as for the finest investigations in polarised light, or for testing objectives with regard to their optical properties in polarised light.

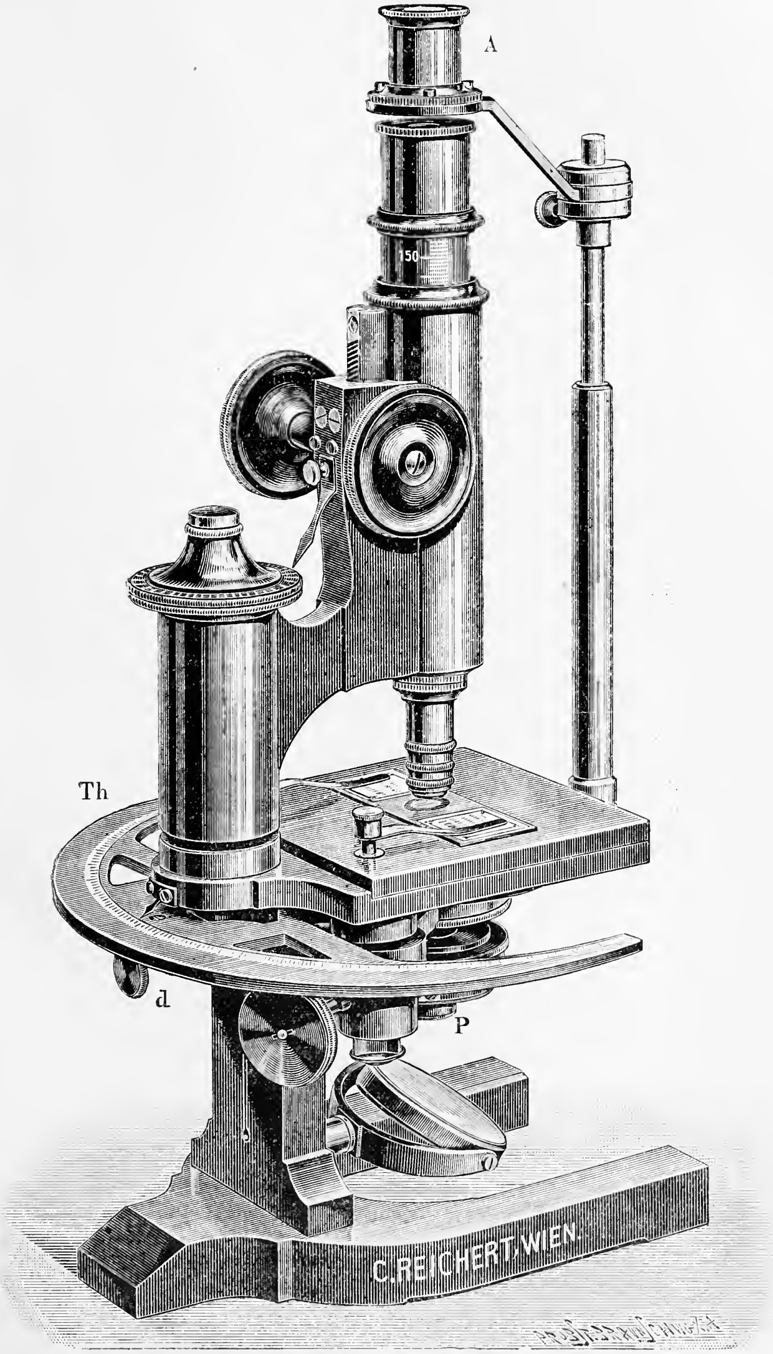
Reichert's "Austria" Microscope.—This stand (No. iii. in catalogue) is a well-made form of cheap Microscope (fig. 98). It has the so-called "English" black lacquered tripod foot, is compact in every part, and, though small, is a thoroughly practical instrument, and is strongly recommended to medical students. The coarse-adjustment is by rack-and-pinion, the fine by a new form of micrometer screw. The stage is $3\frac{1}{4} \times 3\frac{3}{8}$ in., ebonite plated, with substage raised and lowered by screw at side. The instrument is fitted with an Abbe chromatic substage condenser with iris diaphragm and plane and concave mirrors.

Reichert's New Pocket Microscope.—This instrument (catalogue number 24*a*) is intended for meat inspection (fig. 99). It has a push-tube movement and micrometer screw. It is supplied in a suitable pocket case.

Reichert's Polarising Hand Microscope.—This is numbered 31*c* in the catalogue, and is intended for use in demonstration classes. The polarising apparatus is so arranged that it can easily be removed, and observations may then be taken without it. The adjustments are by push-movements of the tubes (fig. 100).

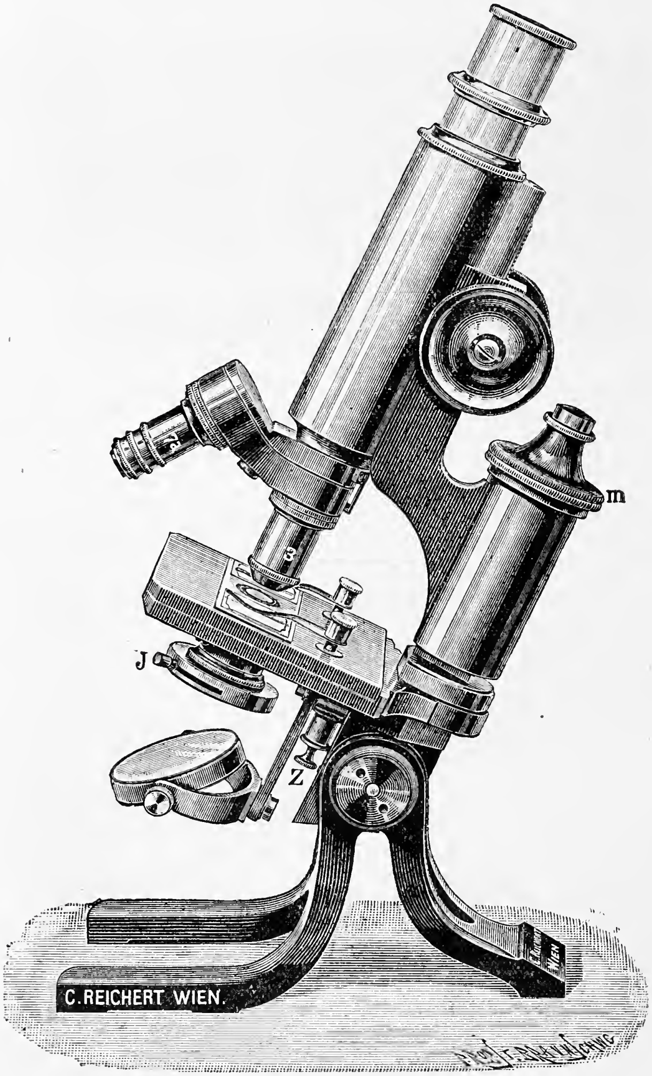
* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

Fig. 97.



Eternod's New Large Model Mechanical Stage.*—Messrs. Leitz have made this piece of apparatus (fig. 101) to Prof. Eternod's design,

Fig. 98.

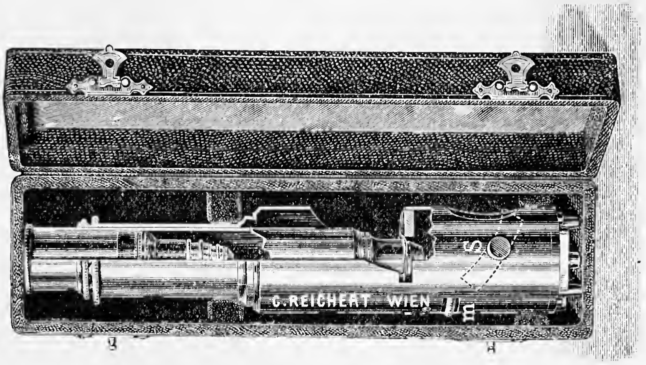


which has rectangular movements of 62 and 42 mm. respectively, and is especially adapted for the examination of serial sections. [To

* Zeitschr. f. wiss. Mikr, xv. (1899) pp. 417–19 (1 fig.).

facilitate the lateral movement of 62 mm., a small crank *a* has been inserted in the right-hand milled head, and a notch in the vertical

FIG. 99.



column allows the full extent in the other direction. The inventor has found the stage of great assistance, especially when he wished to draw by the camera lucida the developments in a series of sections.

FIG. 100.

Adaptation of Greenough's Binocular to the Ordinary Microscope.* — Prof. Eternod criticises Greenough's binocular as a valuable piece of apparatus, but bulky, embarrassing, and costly. Messrs. Zeiss have however supplied him with the binocular tube and lenses, which he has succeeded in fitting to an ordinary stage, and thus reducing the binocular to the rank of a simple accessory. A rackwork (fig. 101, *b*), prepared by his assistant, Mr. Jaccard, provided the necessary attachment, and it was found very convenient to be able to use the instrument in a slanting position. Moreover Abbe's illuminating apparatus exactly suited it, and the inspection of objects in series, such as embryo sections, gained a precision unattainable with a single tube.

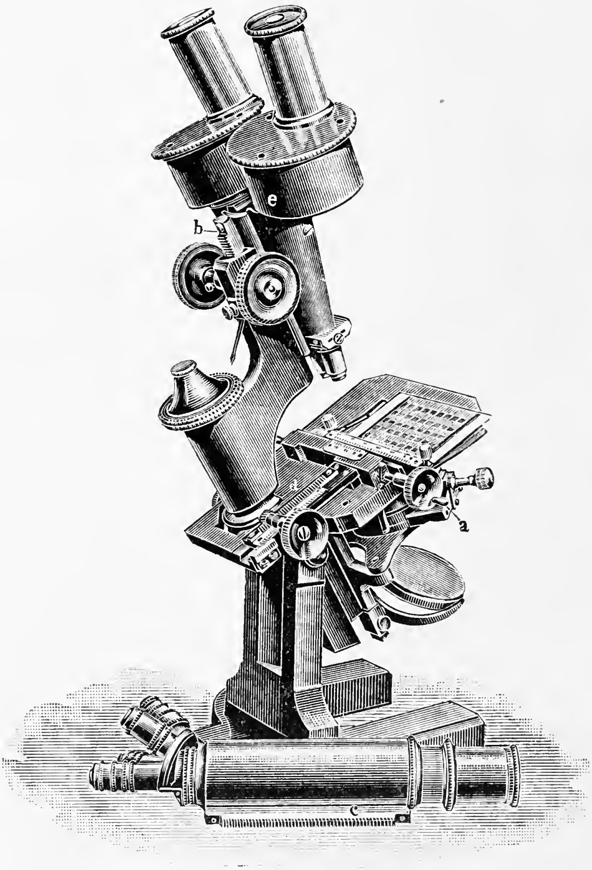
Reichert's New Coarse Adjustment.—The principle is the rack-and-pinion (fig. 102), which is made of gun-metal specially hardened, and a very important feature is the springing with adjusting screws, *a*, *b*, *c*, for tightening up. The tube-mount is regulated by *a*, and the pinion by *b*, *c*; thus the unavoidable wear and tear can be compensated for.

* Zeitschr. f. wiss. Mikr., xv. (1899) pp. 419-21.

(2) Eye-pieces and Objectives.

Primitive Form of Lens-correction.—An interesting old adjusting 1/8 objective by Andrew Ross, which formerly belonged to Prof. Lindley, the second President of this Society (1842, 43), has been presented by his son, the Master of the Rolls. It will be remembered that, owing to Mr. J. J. Lister's paper on the two aplanatic foci of an objective, published

Fig. 101.



in 1836, Mr. Ross was, next year (1837), able to point out that, by means of lens distance, the aberration caused by the thickness of the cover-glass could be corrected. Two years after this, viz. in 1839, we have a drawing* of the mechanism by which this correction, or lens distancing, was effected; it will be unnecessary to describe it, as it is the ordinary screw-collar actuating the front lens of the objective. In

* 'Penny Cyclopædia,' Art. Microscope.

1841 Mr. James Smith graduated the collar, and in 1871 (published 1873) Dr. R. L. Maddox caused the mechanism to actuate the back lenses instead of the front, which is the form of correction at present in use.

Now, if we turn to the figure (fig. 103) we shall find a very early and primitive form of correcting lens. The tube carrying the front

FIG. 102.

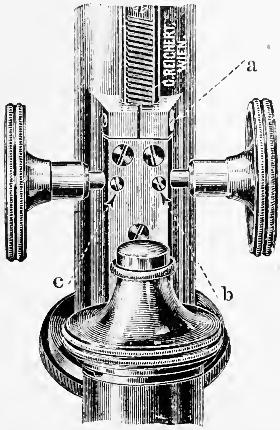
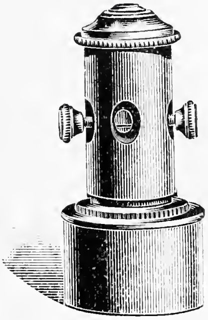


FIG. 103.



lens slides on an inner tube; it can be clamped in any position by the screws at the sides; the line in the little hole in the front indicates its position, and is the prototype of the "covered" and "uncovered" lines of later times. This interesting and very rare object-glass can safely be dated 1838. (The larger cylinder at the base is the lid of its box upon which it is standing.)

Effect of Cover-glass Thickness on the Performance of Wide Aperture Dry Objectives.* — Mr. F. J. Keeley, of Philadelphia, in discussing this subject, points out the well-known fact that even an adjustable objective will do better work at certain cover-glass thicknesses and tube-lengths than at others. This frequently arises from the fact of the adjustment having been made for a cover of greater thickness than the one actually used by the observer. In such cases another cover of suitable thickness attached by a drop of immersion oil to the fixed cover will procure a resolution of the object.

Nomenclature of Objectives. — Mr. F. Howard Collins, F.R.M.S., sends us a communication on this subject, containing a proposal, on which he invites discussion. After pointing out how little the true character of objectives is described by the present system of designating them alphabetically—a system whose value differs with every maker—he recommends an extension of the notation now so successfully used with eye-pieces. His proposal is to call them by the initial

* Micr. Bull. Philadelphia, 1899, pp. 12-13.

magnification they give if used as a single lens at the distance of distinct vision, or 10 in. This magnification, in addition to focal length and numerical aperture, should be engraved upon the mount. He thinks that in time the statement of magnification would be recognised as the proper description of the lens; and that the operator would gain greatly by knowing exactly the quality of his apparatus.

WHITE, JONA—**More about Achromatic Condenser Construction.**
[The author advocates use of slides of medium thickness.]
Micr. Bulletin (Philadelphia), April 1899, pp. 9-11.

KEELEY, F. J.—**Some further Discussion on Achromatic Condensers.**
[Adjustability of objectives and condensers advocated.]
Micr. Bulletin (Philadelphia), April 1899, p. 11.

(3) Illuminating and other Apparatus.

Electrically Heated Stage. — Reichert's electrically heated stage, exhibited at the Meeting of the Society on May 17th, is represented in figs. 104, 105.

It consists of a stage and a contact-breaker. The stage is a metal case, 24 mm. high, containing a coil which is connected with the main circuit m^2 n^2, and filled with paraffin oil. The regulator consists of a contact-thermometer R r, fig. 104, encased in the stage, and an electro-magnetic contact-breaker contained in a separate box. The contact-thermometer is connected with the electro-magnet, and closes and opens the circuit of the battery B, which goes to the electro-magnetic contact-breaker. This latter closes and opens the main circuit.

When putting the apparatus into action, attention is to be paid to the following points:—(A) The heating of the stage is effected by the main circuit; (B) The regulation of the temperature is effected by the auxiliary current.

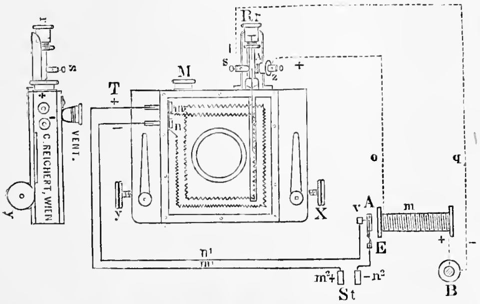
A. *Heating of the Stage.*—(1) The main circuit is connected with the contact-breaker by means of the cable St St', the current thus entering the battery. (2) The contact-breaker is connected with the stage by means of the cable T T'. The current enters the stage, and heats the paraffin oil and thus the whole stage.

B. *Regulation of the Temperature.*—The battery is connected at R with the contact-thermometer at R'. If now the mercury of the thermometer is made to rise by the heating of the stage, and thereby touches the platinum in this thermometer, the main circuit is interrupted. The temperature then begins to fall, the mercury-column again contracts, and the main current passes once more through the stage, and the temperature begins to rise again, the mercury-column again reaches the platinum, and the circuit is once more interrupted. This process is again and again repeated.

The most important point for keeping the stage in action, is to connect the cables well with the stage and the contact-breaker. For this purpose the parts belonging to each are marked by corresponding letters, thus the pin A fits the opening at A; the pin B fits the opening at B, &c. &c. The black cable belongs to the black contact; the yellow cable to the yellow contact.

Through the coil there passes but a very weak current (0·2 ampère). The contact-thermometer being very sensitive, there is no difficulty in maintaining constancy of temperature within 0·1° C. Experimentally, it has been shown that a certain temperature can be maintained constant for days. In adjusting the stage for the certain temperature, say 37° C., all that is needed is to pass the main current through the coil until the thermometer reads 37°; the screw R *r*, with its platinum point, is then turned inwards until a click of the electro-magnetic contact-breaker indicates that the platinum point and the mercury are in contact. The apparatus is now regulated for a constant temperature of 37°. In order to adjust the regulator for a higher temperature, say 45° C., it is only necessary to turn the screw R *r* back until the thermometer indicates the

FIG. 104.



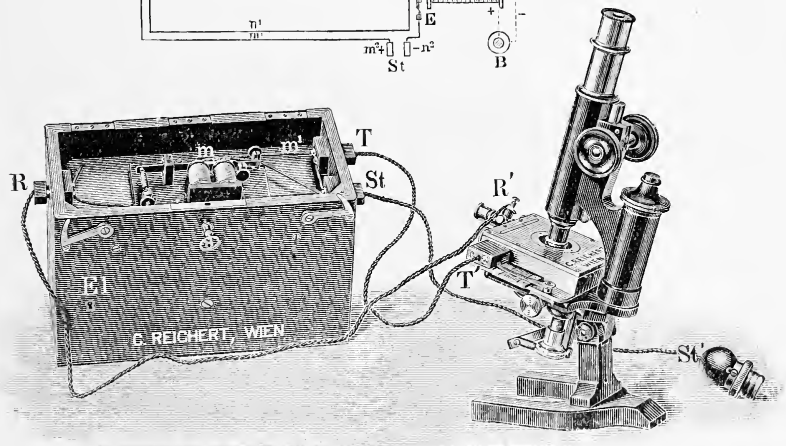


FIG. 105.

desired temperature. The transition from a higher to a lower temperature is effected in the simplest way by breaking the main current for a short time until the temperature falls to the required point; the platinum point is then placed at the degree which indicates the desired temperature. In the event of the temperature falling below the required point, it is only necessary to turn the screw R *r* slowly back; this causes the temperature in the stage to rise again; and as soon as the required temperature is reached, the screw is slowly turned inwards until the clicking of the magnet indicates the completion of the circuit. The apparatus is thus adjusted for a constant temperature.

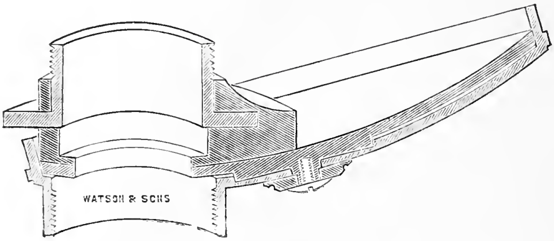
From the preceding it will be seen that this electrically heated stage possesses the following advantages:—

(1) It can be rapidly adjusted for a certain temperature, which can be kept constant within 0·1° C.

(2) The temperature can be raised or lowered, and again rendered constant, by simply turning the adjustment-screw of the contact-thermometer.

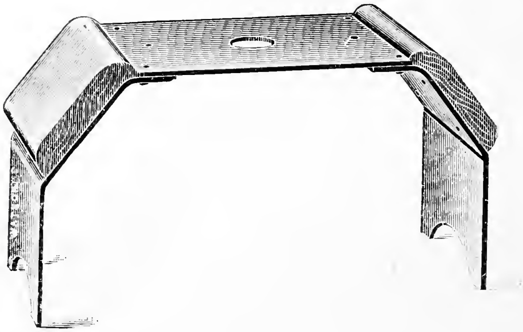
Dust-proof Triple Nose-piece.—In Fig. 106 we give a drawing of Messrs. W. Watson and Sons' triple nose-piece, designed for the purpose of protection from dust. The total diameter of the nose-piece is 2 inches and an eighth.

FIG. 106.



Watson's Table-Stage.— Fig. 107 represents the table-stage designed by Mr. G. T. West, and made by Messrs. Watson and Sons, exhibited at the Meeting of the Society on May 17th, and described on p. 355 of this Journal.

FIG. 107.



(4) Photomicrography.

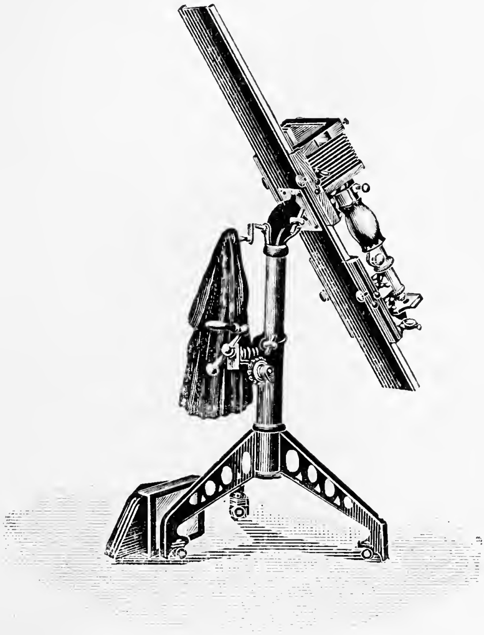
Bitting's Photomicrographic Apparatus.*—Mr. A. W. Bitting intends his apparatus to meet all the needs of laboratory work.

Fig. 108 shows the instrument in an inclined position. The apparatus

* Proc. Indiana Acad. Sci., 1897, pp. 78–80 (1 fig.).

consists of an upright cast-iron post supported by three cast legs, and in it slides the elevating post, worked by a sprocket wheel. The upright post with its legs is 28 inches high; the elevating post is of equal length, and is made of two-inch steel tubing. Upon the top of the elevating post is a head-post, which receives the bed-plate for carrying the camera and Microscope. The head-post is turned to exactly fit the tube, and permits the bed-plate to be revolved on its horizontal axis. The bed-plate is 60 inches long and $5\frac{1}{2}$ inches wide, and consists of a piece of 3/16 in.

Fig. 108.



rolled steel, to which are riveted two dressed half-inch steel tubes. These tubes are placed near each edge, and give rigidity as well as serving for guides for the camera and Microscope carriages. In the centre of the bed-plate is a rack for the adjustment of the camera and Microscope. The bed-plate is arranged to rotate upon its vertical axis. The stand is provided with castors so adjusted that it may be thrown off its legs with the foot. The apparatus can be used in the vertical or horizontal position, or at any inclination.

(5) Microscopical Optics and Manipulation.

Ward, R. Halsted, M.D.—**Localising Microscope Objects.**

[Advocates the noting of their angular position in terms of a clock-face.]

Micr. Bulletin (Philadelphia), April 1899, p. 12.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

New Observation Media.†—M. J. Amann recommends the following media as suitable for clarifying and observation purposes.

(1) *Chloralphenol* is prepared by mixing 2 parts of chloral hydrate and 1 part of pure phenol. This makes an oily fluid, which begins to crystallise at 10° C. The refractive index is 1·5241. It possesses good clearing properties, and delicate histological elements are little, if at all, contracted. For the fixation and rapid demonstration of nuclei, e.g. *Oscillatoriæ*, it is especially useful. It is an excellent dehydrant, and the technique is simple. The living object placed on a slide when treated with chloralphenol is simultaneously killed, fixed, cleared up, and dehydrated. The first quantity should be poured off, and replaced by another. If the specimen be thick or stained or woody, the medium may be heated, and then replaced by balsam added drop by drop.

(2) *Chlorallactophenol* is composed of 2 parts by weight of chloral hydrate, 1 part of pure phenol, and 1 part of lactic acid (sp. gr. 1·21). This is an oily fluid miscible with water. In all proportions $N_D = 1 \cdot 4932$. It clarifies well, and is especially suited for herbarium material, to which it restores the original form. The refractive index can be raised by the addition of salicylate of soda: chloral hydrate 4 parts, phenol 4 parts, lactic acid (sp. gr. 1·21) 2 parts, salicylate of soda 1 part.

(3) *Lactochloral* is a mixture of equal parts of chloral hydrate and lactic acid; $N_D = 1 \cdot 4796$. It clears up well, and can be used for dry material.

(4) *Chlorphenol*, *p*-monochlorphenol (4–1), has a refractive index of 1·5671. It clears up vegetable preparations very strongly, the cell-membrane becoming almost invisible. It is extremely valuable for observing the polarisation picture of organic preparations. It is an excellent dehydrant, does not contract delicate tissues, does not cause the cell-wall to swell up, nor does it affect the colour of chlorophyll.

(5) *Chloralchlorphenol* is a mixture of equal parts of chloral hydrate and *p*-monochlorphenol. It is a thick oily fluid miscible with water, and has a refractive index of 1·5491. It possesses, though in a higher degree, the same properties as chlorphenol.

(6) *Lactochlorphenol* is composed of 1 part of lactic acid and 2 parts of *p*-monochlorphenol. Its refractive index is 1·5265.

(7) *Chlorallactochlorphenol* is composed of equal parts of *p*-monochlorphenol, chloral hydrate, and lactic acid. The refractive index is 1·4995. Preparations treated with this medium, and intended to be mounted in balsam, must be dehydrated with chloralchlorphenol.

(8) *Copper media*. In order better to retain the green colour of preparations, a saturated solution of copper chloride in the proportion of two per thousand may be added to any of the foregoing media.

(9) *Chinolin* has a refractive index of 1·6218, and is very suitable for diatom preparations.

* 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, &c.; (6) Miscellaneous.

† Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 38–44.

Gelatin Culture Media.*—Dr. Erwin F. Smith gives the following hints on the use of gelatin culture media:—The melting point of nutrient gelatins increases as more gelatin is added; it decreases on addition of acids and alkalies, and by long boiling. Grape or cane-sugar added to nutrient gelatin frequently restrains or entirely prevents liquefaction, at the same time stimulating growth. For this reason gelatin should be made with beef broth free from sugar. Owing to the fact that commercial gelatin contains salts which are neutral or alkaline to litmus, but which retard the growth of many organisms, the gelatin medium should first be rendered neutral to phenolphthalein, after which, if desired, it may be acidified to particular acids. A commercial gelatin of uniform character, and washed free from all inhibiting acid substances, is a desideratum.

Raffinose as a Food-Material for Aspergillus.†—M. H. Gillot finds Raulin's fluid‡ the best culture-medium for *Aspergillus niger*. If raffinose is substituted for the saccharose, it is equally consumed by the fungus. *Aspergillus niger* secretes a diastase capable of inverting raffinose, which is completely consumed, the resulting products being dextrose and gelactose. Oxalic acid is also produced, increasing the acidity of the culture-fluid.

Nutrient Media containing Salivary Gland and Mucin.§—Dr. G. Mayer made an elaborate series of experiments to test the effect of the presence of salivary gland and mucin in nutritive media on the growth of micro-organisms. The results are collated in nine tables in which are contrasted the growth of some dozen pathogenic microbes in simple bouillon and agar, with the growth on bouillon and agar containing salivary gland or mucin. The results are shortly summed up as follows. The flesh of young well-nourished animals, especially that of the calf, is better suited for microbic growth than that of other and older animals. The development on salivary gland is better than that on muscle, and at the same time characteristic growth appearances are favoured and promoted. Mucin prepared from bile exerts a somewhat inhibitory action on the development of microbes.

The glands were obtained from different animals, calf, ox, horse, pig, sheep, dog. They were first of all very finely minced, then covered over with an equal bulk of water, and allowed to macerate for 24 hours in the cold. The mass was then pressed, and the thick mucoid fluid thus obtained was steam sterilised for half an hour. The fluid, which is whitish, slightly opalescent, quite neutral, or with only a faintly alkaline reaction, was used alone or mixed with $1\frac{1}{2}$ per cent. agar.

The mucin employed was prepared from bile. It is a yellowish-grey powder which becomes sticky on the addition of fluid. It is soluble under 70° C. to about 0·7 per cent. in water. This was inspissated by evaporating down in a water-bath at 60°–70°, and, after having been

* Bot. Gazette, xxvii. (1899) p. 128.

† Acad. R. Belgique, Bull. Sci., 1899, pp. 211–26.

‡ Water 1500 ccm.; tartaric acid 4·0 grm.; ammonium nitrate 4·0; ammonium phosphate 0·6; potassium carbonate 0·6; magnesium carbonate 0·25; zinc sulphate 0·07; iron sulphate 0·07; potassium silicate 0·07; sugar-candy 70 grm.

§ Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 747–56, 815–26.

sterilised, was mixed with meat-pepton-agar or with bouillon, or used by itself.

Making Blood-Serum Slants.*—Dr. E. C. Levy describes an improvement in the technique of making blood-serum culture media. The serum, obtained from the usual source and in the usual way, is run into sterilised test-tubes, a filling funnel or 50 ccm. burette being used for the purpose. Each tube is stopped with a sterilised cork rammed in above the cotton-wool plug. The corks are then tied in. After this, the tubes are placed on the slant in a shallow wire tray. Inside an Arnold steriliser is placed a wire basket, and on this another is laid flat. On the latter is laid the tray with the tubes. A towel is then thrown over the steriliser, the inner lid and outer jacket of which are dispensed with. In 10–20 minutes after getting up steam, the serum will be found coagulated evenly and without any disfiguring bubbles.

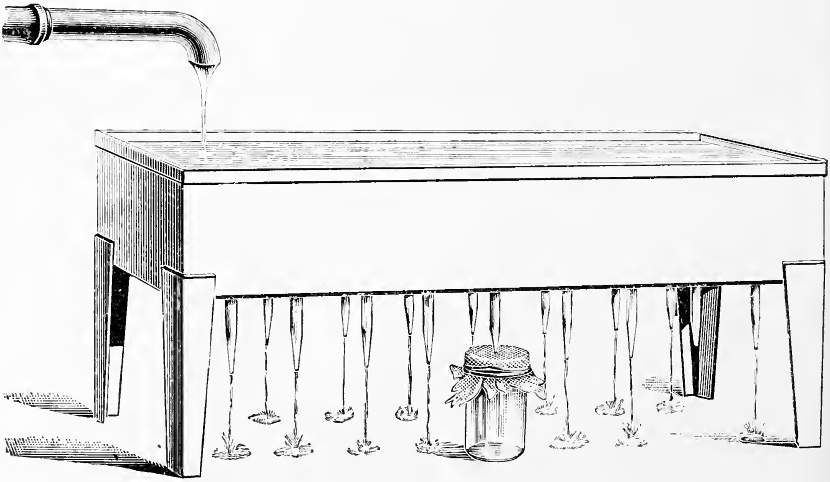
The corks, which should be of the best quality and one or two sizes larger than will easily go into the mouth of the tube, are softened and sterilised in an Arnold steriliser in 20 minutes. In order that the corks may be tied in, the test-tubes must be lipped.

Surplus serum may be kept for future use by pouring it into a well-stoppered bottle, and covering it with a layer 2–3 mm. thick of chloroform. It is then thoroughly shaken. In this way serum is said to keep indefinitely.

(2) Preparing Objects.

Washing Apparatus.†—Mr. E. J. Durand describes a tank which is effective for washing material fixed in chromic acid, Flemming's fluid,

Fig. 109.



&c. It consists (fig. 109) of a trough supported on four legs, and provided with a cork bottom perforated with holes for glass tubes drawn

* Journ. Applied Microscopy, ii. (1899) pp. 360–3 (3 figs.).
† Bot. Gazette, xxvii. (1899) pp. 394–5 (1 fig.).

out to a point at the lower end. When the material is ready for washing, a fine-meshed cloth is stretched over the mouth of the bottle and held in place by a rubber band. The bottle is then placed beneath the trough, and one of the tubes lowered until the pointed end projects through the cloth into the bottle. The water passes off through the meshes of the cloth. A convenient size for the trough, which may be made of tin, is 6·25 cm. deep by 8·75 cm. by 29·5 cm., so as to fit the ordinary sheet of insect cork. The space beneath is 7·5 cm. high. The cork should be at least 1 cm. thick. The holes are 1·8 cm. from the edge and 3·75 cm. apart. This will allow of eighteen 25 mm. bottles being washed at once. The glass tubes are 6·75 long with an inside diameter of 3 mm.

New Preservative Method for Plankton Flagellata.* — Herr O. Zacharias succeeded in fixing *Uroglæna* balls in a mixture of two volumes saturated boric acid solution and three volumes of saturated sublimate solution so satisfactorily that they were afterwards preserved in dilute formol or alcohol without detriment. To the freshly taken plankton was added about one-third its bulk of the mixture, and after about three hours the material was carefully washed on a gauze filter. The material was finally preserved in 2 per cent. formol or in 50 per cent. alcohol, afterwards changed to 70 per cent.

The same method may be adopted if Dinobrya be in the plankton catch.

Diatoms and Loricata are well fixed by the mixture, but it is not advisable to use it for small Crustacea. The latter are better treated with chromacetic acid.

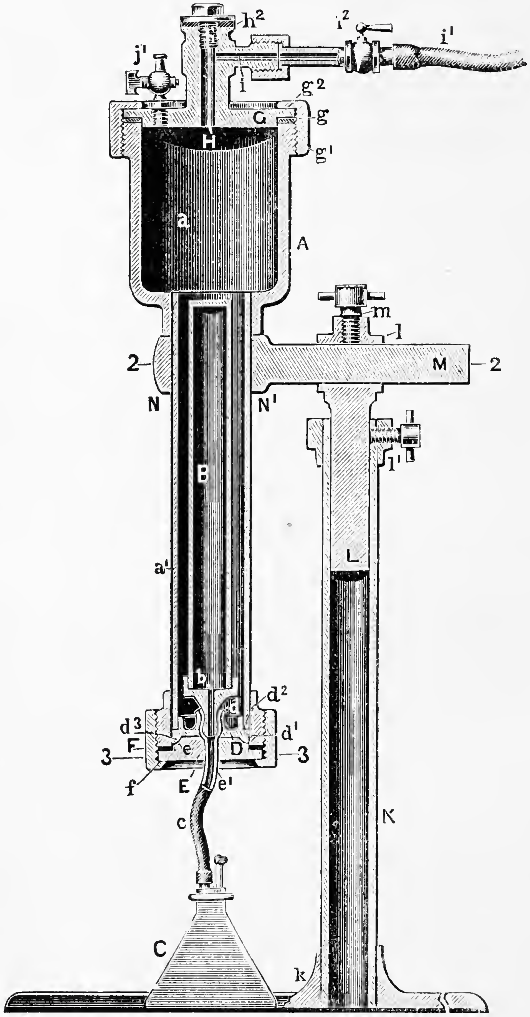
Gaylord's New Apparatus for Liquid Filtration by Gas Pressure through Bacterial Bougies.† — Dr. H. R. Gaylord, of Buffalo University, describes his apparatus as an improvement and modification of Given and Campbell's, described in 1895; it also resembles D'Arsonval's. The application of air pressure has the advantage that the liquid, after filtration, is led into a vessel, out of which the gas (CO_2) given off through the bougie can immediately escape. As the gas escapes outwards from within, the entrance of bacteria-laden air is rendered impossible.

The apparatus (fig. 110) consists in its upper part of a wide chamber for the reception of the liquid to be filtered; while in the lower part, containing the bougie, it is narrower. The material is copper, and its pressure resistance about 300 lb. The pressure is applied from a cylinder charged with carbonic acid; and the apparatus is adapted for Pasteur's and Borkfeldt's bougies of the usual size. The bougie B has its exit at *b*, and is surrounded by a caoutchouc tube *c*; D is the caoutchouc Pasteur stopper; the flask C has a doubly bored stopper, the tube *c* passing through one of the openings, and a plug of wadding closing a glass tube inserted in the other. The glass tube on which *c* is fitted is kept in its place and firmly clamped by the ring F. There is sufficient space between E and the end of the filter, so that when the ring F is almost screwed up, the pressure on the stopper D at d_1 becomes

* Zool. Anzeig., xxii. (1899) pp. 70–2. See Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 67–8.
† Zeitschr. f. wiss. Mikr., xv. (1899) pp. 427–32 (5 figs.).

intensified owing to the pressure within the filter, the jaws *d* of the caoutchouc stopper are pressed firmly against the vent, and all escape of gas and liquid prevented. The large upper opening is closed by the lid G, kept in position by the metal ring g_1, g_2 and the washer g.

Fig. 110.



This lid is perforated by two orifices, H and j_1. The liquid to be filtered is poured in through H after removal of the screw h_1; and the pressure is communicated from the above-mentioned cylinder through the tube i_1 and controlled by the cock i_2. In filling, the cap h_1 is unscrewed and the vent j_1 opened; the gas escapes through j_1 as the liquid enters through k_1; the cap is then firmly screwed on and filtering can begin.

Fig. 111.

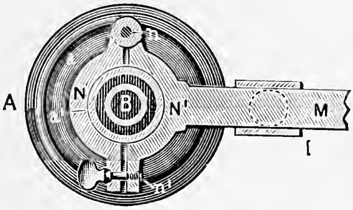
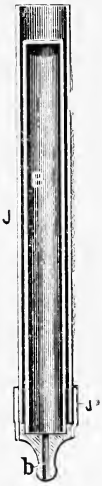


Fig. 112.

By means of an arm M (fig. 111), the apparatus is held in a clamp-ring N_1; and the arm is hinged at n so that the apparatus may be removed for sterilisation and easily cleaned. The arm forms part of a hollow tripod stand, and can be raised up and down in a tube K; it can also be rotated, and clamped in any desired position by the screw l_1.

Fig. 113.

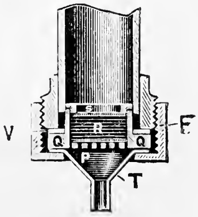


In order to sterilise small quantities of liquids, the bougie can be jacketed in a glass tube (fig. 113) of suitable diameter. A caoutchouc band J_1 is passed round jacket and bougie, and the whole placed in the filter. This application is very advantageous.

Fig. 112 shows a cross-section of E surrounded by the ring F, and of the caoutchouc tube c penetrating through the opening e_1 of E.

For the filtration of a litre of blood-serum 5 to 10 minutes suffices, and the end of the process is indicated by the passing of the acid through the bougie and the frothing-up of the liquid in the flask C. The cock i_2 is then shut off and j_1 opened; the pressure being thus released and the process completed. The tube c is closed by a pinch-cock and, together with the flask C, removed.

Fig. 114.



If it should be desired to filter also the liquid remaining in the filter, the apparatus is inverted so that the liquid runs into the large upper part, the bougie is removed and the jacket tube J inserted; the apparatus is thus restored to its first position, whereby the liquid enters J, and the filtering goes on as before.

By the arrangement shown in fig. 114, such liquids as agar-agar, &c., can be fitered. In this case a metal-piece Q replaces the bougie. Q is perforated and can be covered by fine muslin and several layers of filter paper, any free space being filled with asbestos wool, pressed down by a well-fitting cap S. T is a funnel, and V a washer. 25 lb. of air-pressure suffices to filter a litre of agar-agar in ten minutes, and the usual clarification with white of egg is unnecessary.

Modification of the Celloidin Series Method. — Prof. F. Dimmer * uses a gelatin solution instead of the sugar solution. Some 16 grm. of gelatin are dissolved in 300 grm. of warm water. This solution is then poured over large glass plates, previously warmed and placed in a nearly horizontal position. The thin films, protected from the dust, dry in about two days. The sections are removed from the knife in the usual way and placed on the gelatin plates and kept moist with 70 per cent. alcohol. When a plate is full of sections the excess of alcohol is removed by covering the surface with a piece of closet-paper and pressing out the fluid. The sections are then covered with photoxylin solution (photoxylin 6, absolute alcohol and ether $\bar{a}\,\bar{a}$ 100 ccm.). When this is about dry, the plate is immersed in water at 50°–55° C. When the plates are set free from the glass, they are easily picked up on closet-paper and transferred to a staining or clarifying fluid.

The modification devised by Mr. J. S. Kingsley † consists in hardening the collodion-saturated mass in chloroform, and when firm placing the block in a mixture of 1 part carbolic acid and 3 parts xylol. The sections are cut with a razor flooded with the xylol-carbolic acid, transferred to a slide, and mounted directly in balsam.

Bacteriological Notes.‡—(1) Herr London has found that if cover-glass preparations of the cholera vibrio be treated with a mixture composed of 1 part of an alcoholic solution of picric acid and 2 parts of water for one minute, and then washed in water for 15 minutes, the cholera vibrios are stained by the picric acid. All other bacteria are decolorised.

(2) The above-mentioned picric acid solution may be substituted for the iodopotassic iodide solution in Gram's method.

(3) Clove-oil water is better than anilin-oil water for making Ehrlich's fuchsin solution. There is no precipitate, and in the dark the fuchsin solution will keep for two months.

(4) A 1 per cent. solution of thionin stains the tissues blue and the bacteria violet. Hence this metachromatism may be made use of with advantage for staining bacteria in tissues.

(5) The author recommends the use of karagen plates made like gelatin plates for the culture of Amœbæ.

Use of Acetone in Histology.§ — Dr. P. A. Fish states that the action of acetone on pyroxylin is more intense than that of the ether-alcohol mixture used for dissolving celloidin. It is also a fixing, hardening, and dehydrating agent. Hence it may be used as follows:— Fix in 70 per cent. acetone; dehydrate in strong acetone; soak in 4 per cent. acetone-collodion; then in 8 per cent. acetone-collodion.

New Nissl Method.‖—Dr. J. R. Lord makes sections of fresh tissue with a freezing microtome, and fixes the sections in the following solu-

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 44–6.
† Journ. Applied Microscopy, ii. (1899) p. 325.
‡ Arch. Biol. Wissensch. St. Petersburg, 1898, p. 319. See Centralbl. Bakt. u. Par., 1te Abt. xxv. (1899), p. 839.
§ Journ. Applied Microscopy, ii. (1899) pp. 322–4.
‖ Journ. Mental Science, xliv. (1898) pp. 693–700 (1 pl.).

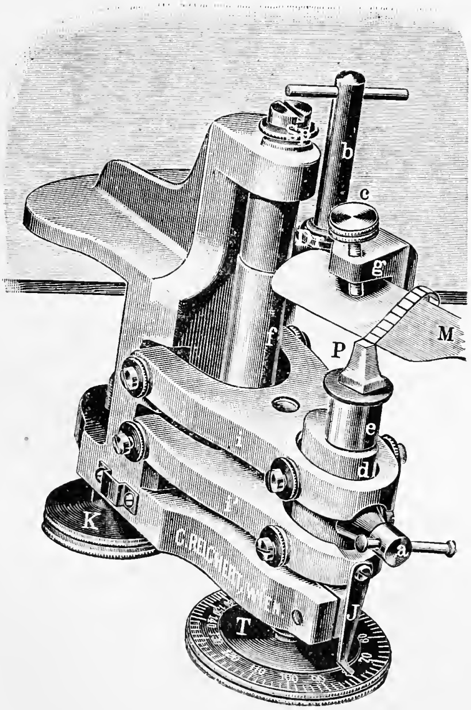
tions:—Saturated aqueous solution of picric acid 50 per cent.; 6 per cent. solution of formol in water 50 per cent.

The sections are floated on the fixative dropped on the slide, and after 5–15 seconds are floated back on water. They are then returned to a slide, on which some 0·5 per cent. methylen-blue, patent B, has been pipetted. The slide is heated until a bubble appears, and is then allowed to cool. The excess of stain is washed off and the preparation heated with 10 per cent. anilin oil in absolute alcohol until no more stain is given off. The section is then mopped up with blotting-paper, and cleared with origanum oil, the last traces of which are removed with benzin. It is finally mounted in colophonium prepared by heating the resin in a porcelain capsule together with a very little benzin. The colophonium is smeared over the surface of the section with a glass rod. A cover-glass is imposed and the preparation heated until the cover-glass is in position.

(3) Cutting, including Imbedding and Microtomes.

Reichert's Microtome with Conical Bearings.—This (fig. 115) is intended for paraffin sections and for small histological objects. It has

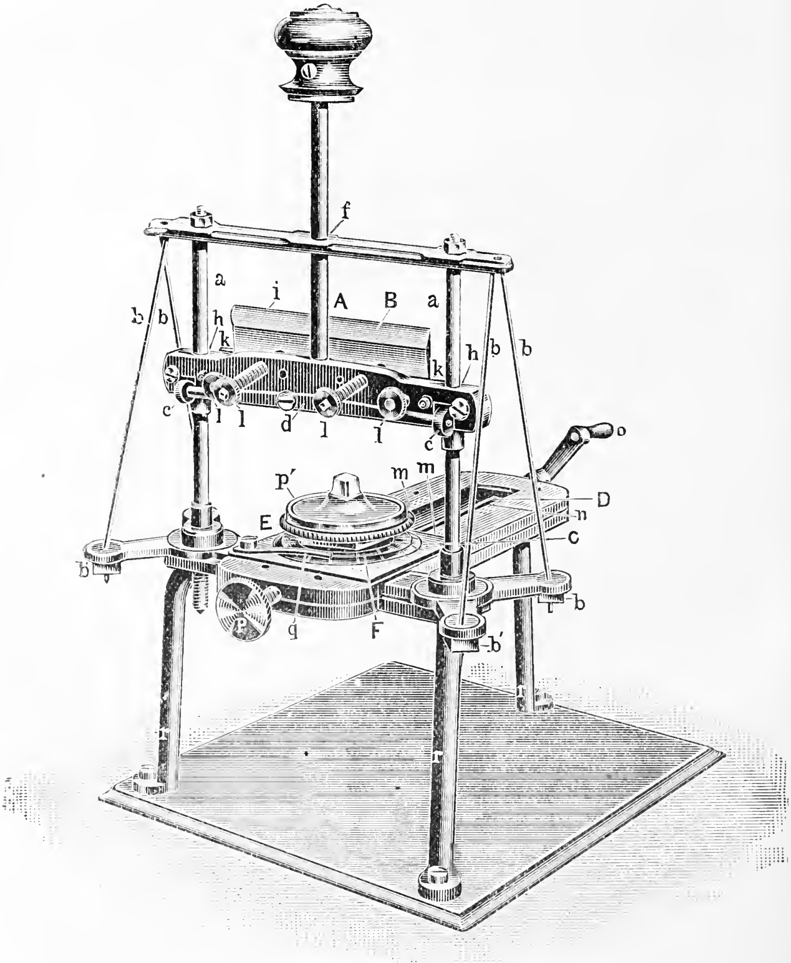
Fig. 115.



an adjustable knife-carrier, a micrometer-screw for raising the object, a screw for clamping to table, a screw for holding the object firmly, a simple freezing apparatus, and a razor.

New Apparatus for Cutting Paraffin Cubes.* — Such pieces of apparatus are usually accessories of the microtome, more or less troublesome to manage, and dangerous to the fingers. Prof. Eternod, with the help of his assistant, M. Jaccard, has tried to design a special instrument for this purpose, consisting (fig. 116) of (1) a guillotine A,

Fig. 116.



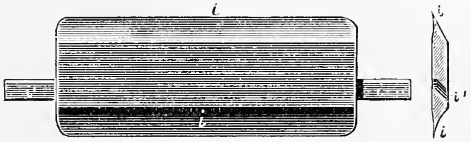
with vertical slides; (2) a razor B; (3) a horizontal carrier C, (4) moved by a screw of special precision D; (5) surmounted by the bearer E of the plug-carrier; (6) a graduated and pivoted dial F giving the exact angle required for the sections.

* Zeitschr. f. wiss. Mikr., xv. (1899) pp. 421–5 (5 figs.).

The guillotine A moves up and down two perfectly straight steel bars *a*, *a*, which act as slides and are kept rigid by guys *b*, *b*, *b*, *b*, each controllable by a special nut *b'*, *b'*, *b'*. To render the movement more exact or delicate, the guillotine is provided with two rollers *c*, *c*, mounted on a strong steel spring *d*, which exerts a sufficiently strong pressure on the steel bars. The regular movement of the guillotine is, moreover, secured by making the handle pass through a hole *f* on a higher level than the sliding-holes *h h* of the guillotine.

The razor B (fig. 117) is formed by a blade of fine steel with two cutting edges *i*, *i*; it is thick, scarcely flexible, and is provided with two

Fig. 117.



ears or trunnions for fixing to the guillotine. Fixing is attained by slipping the razor into two oblique notches *k k*. Immobility and obliquity are accomplished by manœuvring four screw-bolts, placed two and two on the body of the guillotine *l*, *l*, *l*, *l*.

The horizontal carrier C bears two lateral notches which engage in two long and solid horizontal slides *m*, on which certain graduations allow the determination in advance of the precise width desired for the paraffin blocks, so as to produce ribbons of required length, and of the required number of sections for the said length.

The precision screw D, moved by a crank O, displaces horizontally the carrier with the paraffin block. This screw has a thread interval of about half a millimetre, and is kept exactly in its place, without unsteadiness, by a screw *p*, whose hollowed-out end receives the end of the precision screw.

The horizontal carrier C is surmounted by a supporting piece E, intended to receive the ordinary block-bearers *p'* formed of a disc fitted with a metallic stem, on which the paraffin blocks have been previously soldered. A hole bored in E receives the butt of the block-bearer, steadied by a small bolt; neither hole nor bolt is visible in the figure.

Around the base of E is a graduated dial F, regularly notched for receiving the catch of a special spring *q*. By means of these graduations, notches, and spring, the paraffin blocks can be accurately set at various angles, and cut geometrically to the desired form. The supporting piece and dial, really one, turn upon a pivot accurately centered in the carrier. A small index, not visible in the figure, reads off the dial graduations and section angles.

The two razor-edges are 8·5 cm. long, and the total height of the instrument is 35 cm.

In the orientation of series-sections on the slide, Prof. Eternod states that the best plan is to cut the paraffin blocks into accurately right-angled parallelopipeds, and afterwards slightly cut away the sharp angles (fig. 118). The sections should be placed on the slide, the same number in each row, and if possible, in five rows of ten each (see fig. 119). In reconstruction it is easy then, by help of the mechanical stage, to select the sections by fives or tens.

Fig. 118.

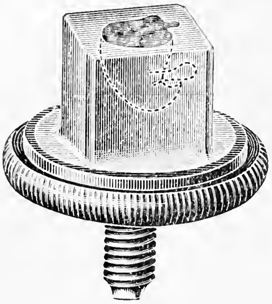
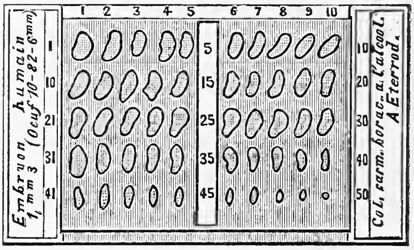
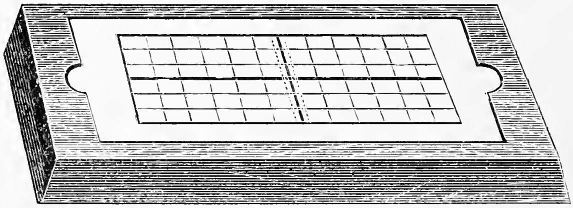


Fig. 119.



To facilitate the setting-out of the sections, a small wooden tray (fig. 120), hollowed out to the exact size of the object-slide and marked with lines, will be found very convenient for placing the ribbons, and for covering them with the glass slide. It is very useful to number the

Fig. 120.



rows of sections on slips of gummed paper, so as to avoid error in numbering the drawings made by the camera lucida. Moreover, the slips are some protection against breakage.

Levison, W. G.—**Photographed Ocular Micrometers.**

[The author has found these in some respects to be more satisfactory for use with any objective than ruled micrometers.]

Ann. New York Acad. of Sci., Dec. 1898, pp. 405–6.

(4) Staining and Injecting.

Combined Fixing and Staining Method.* — Herr M. B. Wermel recommends the following formol staining solutions:—

(1) Methylen-blue F.A.—Methylen-blue, saturated alcoholic solution 30 ccm., formol 2 per cent. aqueous solution 100 ccm. The preparations are treated for 5 to 8 minutes, then washed, dried, and mounted.

(2) Eosin F.—Eosin 1 per cent. solution in 60 per cent., alcohol

* Medizinskoë Obosrenie, 1897, pp. 829–33. See Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 50–4.

100 ccm., formol 10 per cent. aqueous solution 20 ccm. If used for staining blood, the blood is smeared on the slide with a strip of paper. It is dried in the air, and the solution is then dropped on. After 2 minutes the excess of staining solution is poured off, and on the still damp preparation is dropped methylen-blue F.B. After another two minutes the preparation is thoroughly washed with water, dried, and mounted in balsam.

(3) Methylen-blue F.B.—Methylen-blue saturated aqueous solution 1 part; formol 4 per cent. aqueous solution 1 part. When staining pus or gonococci in urine, the air-dried film is first treated with eosin F., and after two minutes is thoroughly washed with water. It is then treated for 30 seconds with an aqueous saturated solution of methylen-blue diluted before use in the proportion of 1–3. The preparation is then carefully washed with water.

For staining by Gram's method, gentian-violet F. is used.—Gentian-violet 10 per cent. alcoholic solution 10 ccm.; formol 2·5 per cent. aqueous solution 100 ccm. The preparation is first treated with the gentian-violet F. solution for 5 minutes, and then with the iodopotassic iodide solution for 2 minutes. This is followed by decolorising in 10 per cent. alcoholic solution of aceton. After having been washed in water, the preparation is contrast stained with Bismarck-brown for 30 seconds. It is again washed in water, and dried.

Staining Solutions made with Pyroligneous Acid.* — Herr E. Burchardt gives the following formulæ for staining solutions containing pyroligneous acid:—

(1) Pyroligneous acid hæmatoxylin.—Pyroligneous acid 130·0 parts; potash alum 2·0; hæmatoxylin 0·5. The alum is first dissolved in the pyroligneous acid, and then the hæmatoxylin dissolved in strong spirit is added. After exposure to light for 12 days the solution is ready for use. It is a permanent stain, but the staining power decreases with lapse of time. The strength of the solution may, however, be restored by the addition of a little pyroligneous acid. The solution is useful for staining either in mass or in section. The pieces or sections are to be transferred directly from alcohol to the stain, wherein they remain for 12 hours or longer, according to their size. On removal they are thoroughly washed in 50 per cent. alcohol, and then treated in the ordinary way.

(2) Pyroligneous acid carmine.—Carmine Xr: pyroligneous acid 100 parts; carmine 2. The mixture is to be heated slowly over a small flame, evaporated down to one-half, and filtered when cold. The pieces to be stained are immersed in the solution for 12–24 hours, and then washed in 50 per cent. alcohol. Next they are differentiated in alum-alcohol (50 per cent. alcohol saturated with alum). This takes 2 or 3 days; after this they are washed in 50 per cent. spirit, and treated in the usual way.

Carmine Pr.: Pyroligneous acid 100 parts; carmine 3; potash-alum 0·5. Evaporate down to one-half, and filter when cold. Stain for 2–24 hours, and wash in 50 per cent. alcohol.

Carmine Xr + Pr (double carmine): Mix equal bulks of the foregoing.

* Arch. f. Mikr. Anat., liii. (1898) pp. 232–7. See Zeitschr. f. wiss. Mikr., xv. (1899) pp. 453–5.

Stain for 6–24 hours, and then soak in 50 per cent. alcohol for 1–12 hours. Sometimes it is expedient to differentiate in alum-alcohol.

(3) Pyroligneous acid cochineal. — Pyroligneous acid 100 parts; cochineal 4; potash-alum 0·5. Boil down to one-half and filter. Immerse for 12–24 hours, soak in 50 per cent. alcohol, differentiate in alum-alcohol, and proceed as usual.

Weigert-Pal Staining of very young Brains.*—Herr A. Dölken gives the following procedure for staining the brains of very young animals by the Weigert-Pal method. Sections of about 50 μ thick (in rats and mice they should be not more than 30 μ), are cut, and placed for more convenient manipulation on photoxylin plates. They are then placed in cold hæmatoxylin solution (Pal) for 4–5 days, after which they are incubated in the staining solution at 37° for 2 hours. When cold they are immersed in tap water for 6–8 hours, and then in alkaline distilled water (2–3 drops KHO to 1 litre) for a quarter of an hour. The sections are next decolorised in permanganate of potash solution, about 0·5 per cent., until the undeveloped non-medullated areas are just beginning to become transparent. After having been well washed in distilled water, they are immersed in 1 per cent. oxalic acid solution until the non-medullated spots look pale brown, the cortex and nuclei being somewhat darker. Thereupon they are washed in distilled water, after which the fibres appear dark blue, the cortex and nuclei light brown to yellow, the undeveloped non-medullated places pale yellow to white.

The material should be fixed in 5–10 per cent. formaldehyd or in ethylaldehyd for 2–4 weeks, and then hardened in bichromate for 5–7 months.

New Method of Staining Malaria Parasites.† — Dr. Futcher and Dr. Lazear recommend the following new combination of old methods for staining malaria parasites. The dried films are to be fixed in freshly made formalin-alcohol (4–5 drops of 10 per cent. formalin to 10 ccm. of 95 per cent. alcohol). Immerse for 1 minute, then wash in water, blot, and dry. Stain for 10–15 seconds in a saturated solution of thionin in 50 per cent. alcohol, of which 20 ccm. are added to 100 ccm. of 2 per cent. carbolic acid. Then wash, blot, dry, and mount in balsam.

Staining Spinal Cord Cells.‡—Mr. E. P. Sargent recommends the following procedure for staining the principal elements in the spinal cord of *Ctenolabrus cœruleus*. The material is fixed in 10 per cent. and afterwards in 5 per cent. formol. After having been washed in water, it is immersed for 24 hours in 5 per cent. solution of copper sulphate. It is then sectioned, and the sections, which had been placed on slides, are stained for 15–30 minutes in the following mixture:—Phosphor-molybdic acid 10 per cent. solution 1 ccm.; hæmatoxylin crystals 1 grm.; chloral hydrate 10 grm.; water 400 ccm.

The preparations are then washed, dehydrated, cleared up, and mounted in the usual way. The nerve-fibres, neuroglia, and dendrites of the ganglion-cells are well stained.

* Zeitschr. f. wiss. Mikr., xv. (1899) pp. 443–5.
† Johns Hopkins Hosp. Bull., x. (1899).
‡ Anat. Anzeig., xv. (1898) pp. 212–25 (10 figs.).

Staining Method for Differentiating Leprosy, Smegma, and Human and Avian Tubercle Bacilli.*—Dr. E. J. Marzinowsky records some observations which tend to show that the bacilli of human and avian tuberculosis, of leprosy, and smegma, can be differentiated by a simple staining procedure. The stains used were ordinary carbol-fuchsin and Loeffler's methylen-blue. *Bac. tuberculosis hominis* does not stain by this method. *B. tuberculosis avium* is easily stained, i.e. it retains the red after having been treated with the methylen-blue solution. *Bac. lepræ* is easily stained, but is decolorised by longer action (10 minutes) of the methylen-blue. *Bac. smegmæ* takes the red stain. Thus, while human tubercle bacilli do not stain at all, the other three do, and these are differentiated by the action of the methylen-blue.

Modified Flemming Stain.†—Mr. H. F. Roberts states that basic fuchsin (1 per cent. aqueous solution) can be satisfactorily substituted for safranin in the Flemming triple stain, and frequently gives a more brilliant red. The manipulation is the same. Slides are best left in the fuchsin overnight, and excess extracted with 35 per cent. alcohol. The extraction is slow enough to be easily controlled.

Modification of the Unna-Tanzer Method for Staining Elastic Fibres.‡—The modification suggested by Sig. F. Livini is a combination of Unna's old and recent orcein methods, and consists of two solutions: (1) Orcein 1 part, hydrochloric acid 1 part, absolute alcohol 100 parts; (2) 95 per cent. alcohol 20 parts, hydrochloric acid 0·1 part, distilled water 5 parts. Thirty drops of the first solution are mixed in a watch-glass with 5–10 ccm. of the second. In this mixture are placed sections of material fixed in sublimate or alcohol. The watch-glass must be covered over to prevent evaporation. The sections remain in the solution some hours or overnight. They are then washed 3 or 4 times in 90 per cent. alcohol, dehydrated, cleared up in origanum-oil, and mounted in balsam. The sections may be after-stained with hæmalum, borax-carmine, &c. if necessary.

Modification of Neisser's Stain for Diphtheria Bacilli.§—Mr. F. Tanner and Dr. A. C. Coles recommend the following modification of Neisser's method. (1) The films from a culture or membrane are spread on slides or cover-glasses, preferably the former. (2) Next fix in the ordinary way by heat or by immersion for a few minutes in equal parts of ether and absolute alcohol. (3) Stain in methylen-blue solution (1 grm. dissolved in 20 ccm. of 96 per cent. alcohol, and mixed with 950 ccm. water and 50 ccm. glacial acetic acid) for 10–30 seconds. (4) After washing, immerse in Gram's iodine solution for 10–30 seconds. (5) Wash in water and stain in vesuvin solution (vesuvin 2 grm. dissolved in 1000 ccm. of boiling distilled water); filter for 10–30 seconds. (6) Dry, and mount in Canada balsam.

Thus stained diphtheria bacilli appear as slender rods of a yellowish-brown colour, containing a granule at each end and sometimes also in the centre.

* Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 762–4.
† Bot. Gazette, xxvii. (1899) p. 398.
‡ Monitore Zool. Ital., vii. (1896) pp. 45–7. See Zeitschr. f. wiss. Mikr., xv. (1899) pp. 476–7.
§ Brit. Med. Journ., 1899, i. p. 1213.

(5) Mounting, including Slides, Preservative Fluids, &c.

Method for Exhibiting Polyzoa.* — Prof. M. Hartog recommends that Polyzoa and other small animals should be mounted in a hanging drop of water on the under side of the cover-glass, luted on to a cell of paraffined millboard. In this way evaporation is prevented, so that *Lophopus* and other Polyzoa may be preserved for 48 hours.

Fluorides of Sodium as Fixatives and Preservatives.† — Herr G. Marpmann calls attention to the fixative and preservative properties of the fluoride and bifluoride of sodium. Solutions of both salts attack glass, the polish of which is destroyed. They are antiseptic, and are more agreeable to work with than either formalin or sublimate. The bifluoride solution is miscible with gelatin solutions.

The following formulæ are given:—

For fixing lower organisms: sodium fluoride 0·5 part; sodium bifluoride 2·0; water 100.

For fixing animal tissues: sodium fluoride 5 parts; sodium chloride 5–10; water 100; or sodium bifluoride 5, water 100.

For mounting reptilia: sodium bifluoride 5 parts; glycerin 50; alcohol 100; water 400.

In the foregoing, the colours of snakes and frogs are well kept, and the animals retain their elasticity better than in sublimate or formalin.

For preserving organs, &c.: sodium bifluoride 5 parts; sodium chloride 30; water 300.

For preserving embryos: sodium bifluoride 4 parts; formol 1; water 100.

For hardening glands and central nervous system: Müller's fluid 100 parts; water 100; sodium bifluoride 5; formol 5. In 4–5 days the objects are sufficiently hardened, and should then be treated with alcohol.

Demonstrating Hæmogregarina Stepanowi.‡—M. A. Laveran recommends the following method for examining the endoglobular parasites of *Cistado europæa*. Blood is smeared on a slide, and when dry is immersed in picric acid for 20–30 minutes. It is then washed in water and stained. Flemming's fluid fixes equally well, but the staining is not so good. The staining solution used was as follows:—Saturated aqueous solution of methylen-blue 2 ccm.; distilled water 4 ccm.; aqueous 1 per cent. solution of eosin 8 drops. The mixture must always be freshly prepared. The objects remain in the solution 6–12 hours, and, after having been washed in water, are rapidly dehydrated in absolute alcohol and mounted in balsam.

Toluidin blue and carbol-thionin also give very useful preparations.

Methyl Salicylate in Histological Technique.§ — M. F. Guéguen recommends the introduction of methyl salicylate into histological technique. It is a colourless fluid with an aromatic odour and a refrac-

* Illustd. Annual of Microscopy, 1898, p. 48.
† Zeitschr. f. angew. Mikr., v. (1899) pp. 33–7.
‡ C.R. Soc. Biol., v. (1898) pp. 885–9. See Zeitschr. f. wiss. Mikr., xv. (1899) p. 461.
§ C.R. Soc. Biol., v. (1898) pp. 285–7. See Zeitschr. f. wiss. Mikr., xv. (1899) pp. 455–6.

tive index of 1·537. Its sp. gr. is 1·18. It mixes in any proportion with alcohol, benzol, toluol, xylol, sulphuric ether, chloroform, and petroleum ether. It would be a suitable medium for saturating objects with paraffin. Fixed and dehydrated tissues are immersed in a mixture of methyl salicylate and absolute alcohol. The proportion of the former is increased until the pure salicylate is reached. The object is saturated when it becomes transparent and sinks to the bottom of the fluid. The paraffin is to be added gradually. Methyl salicylate clarifies the tissues well, and does not affect anilin dyes.

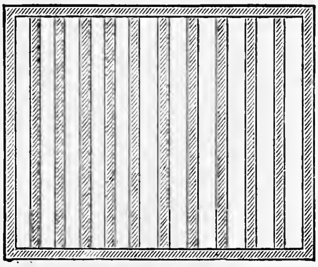
Use of Methylen-blue in Anaerobic Cultivation.*—Prof. G. Kabrhel, taking advantage of the well-known property of reducing agents to decolorise methylen-blue, has devised a method whereby methylen-blue is used as an indicator of the presence or absence of oxygen. The indicator is, of course, intended as an adjunct in the cultivation of anaerobic organisms. The indicator is a test-tube filled with sugar-gelatin coloured with alkaline methylen-blue.

The apparatus used consists of a large bell-jar with a stop-cock at the top. The bell-jar is placed on a flat glass plate, and the two are joined by a mixture of two parts fat and one part tallow. Inside the bell-jar are placed two pans containing pyrogallol, one on top of the other, and separated by strips of glass. The pans are surmounted by a series of uncovered and inoculated capsules. The indicator, which is also placed inside, is not plugged with cotton-wool, and is fixed up with some of the fat-tallow mixture. Caustic potash is added to the pyrogallol, and the stop-cock connected with a hydrogen generator. The excess hydrogen is allowed to escape through a small hole in the tallow-fat junction of the bell-jar and plate. If all conditions have been properly fulfilled, the methylen-blue will be regularly and thoroughly decolorised in about 36 hours.

(6) Miscellaneous.

Apparatus for Preserving Celloidin-Blocks.†—The box constructed for Dr. R. Borrmann for preserving a large number of celloidin-blocks

FIG. 121.

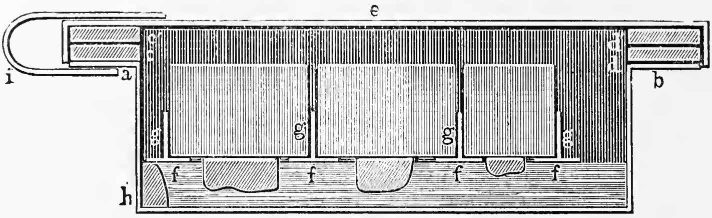


stuck on wood or cork, is made of galvanised iron, and measures 30 by 23 by 3·5 cm. The pan (fig. 122) has a wide lip *a*, *b*, and is surmounted by a lid *e* held on by a clamp *i*. *c' c*, *d' d* are felt pads.

* Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 555–61 (1 fig.).
† Zeitschr. f. wiss. Mikr., xv. (1899) pp. 433–7 (2 figs.).

The pan is divided into a number of parallel compartments by means of a grating (fig. 121). The grating is supported by feet *h*, and, as is seen in fig. 122, each septum is T-shaped, so that a number

FIG. 122.



of shelves are formed upon which the blocks rest. The pan is filled with spirit up to the level of the shelves. In fig. 122 only four out of the twelve divisions are shown.

New Microscopical Cell.*—Mr. Hardy has introduced a new cell called the Vitreous, from the fact that the cell is fused on to the glass slip, thus making it one homogeneous whole, and obviating the risk of the liquid oozing out or the cell curling or moving. The cells are made in various sizes.

Globigerina Shells in Polarised Light.†—Herr W. Schauf states that Globigerina shells, both recent and fossil, when examined in parallel polarised light with crossed nicols, show a dark cross and one or more coloured rings in each chamber. The arms of all the crosses are parallel to one another and to the rotation plane of the nicol. The double refraction is negative.

FIG. 123.

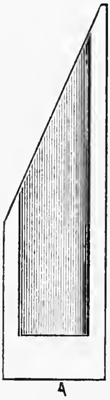
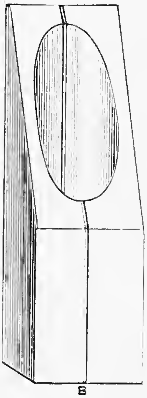


FIG. 124.



Mould for making Gypsum Blocks.‡—Mr. T. Bowhill describes a mould for making gypsum blocks intended for yeast cultures (figs. 123, 124). As will be seen from the illustrations, the cast is cylindrical with a long oblique surface. The two halves of the mould are held together with a rubber band, and, the internal surface having been smeared with paraffin, the plaster is poured in. When the mass has become hard, the block is removed and put in a test-tube along with a little water, and sterilised.

* English Mechanic, lxix. (1899) p. 277.
† Ber. Senckenberg. naturf. Gesellsch. Wiss. Abhandl., 1898, p. 27.
‡ Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 287–8 (2 figs.).

PROCEEDINGS OF THE SOCIETY.

Meeting of the 21st of June, 1899, at 20 Hanover Square, W.
The President (E. M. Nelson, Esq.) in the Chair.

The Minutes of the Meeting of the 17th of May last were read and confirmed, and were signed by the President.

The List of Donations to the Society—exclusive of exchanges and reprints—received since the last Meeting was submitted, and the thanks of the Society were voted to the Donors.

	From
Board of Agriculture, Annual Report of Proceedings under the Diseases of Animals Acts, for the year 1898. (8vo, London, 1899)	*The Board of Agriculture.*
Dr. Henri Van Heurck, Traité des Diatomées. (4to, Anvers, 1899)	*The Author.*
Prof. Ettore de Toni, Diatomee del antico corso Plavense, (4to, Padova, 1899)	*The Author.*
1/8-in. Objective made by Andrew Ross for the late Prof. Lindley	*The Right Hon. Sir Nathaniel Lindley.*

The President exhibited an old 1/8 objective, made by Andrew Ross, which had been presented to the Society by the Master of the Rolls. It was an interesting and very rare form of objective, constructed probably about the year 1838, which possessed a very primitive form of lens adjustment. As lens correction was first invented in 1837, and screw collar correction came into use in 1839, very few objectives of this pattern could have been made. This particular one had a special interest for them, because it formerly belonged to the father of the donor, Prof. John Lindley, the second President of this Society (1842–3). He felt sure that the Meeting would give Lord Justice Lindley a very hearty vote of thanks for the presentation (see p. 436 and fig. 103).

The President said he had received a new coarse adjustment from Messrs. Watson and Son who had acted very promptly upon a suggestion made by him in a paper he read before the Society in March last, and had sent the result to show that with a loose pinion it was possible to have a rackwork that would work without "loss of time." If it showed signs of wear, the second rack could always be stepped a little more, which would put it in perfect adjustment again.

The thanks of the Society were given to Messrs. Watson for sending this model for their inspection.

A paper by Mr. Jas. Yate Johnson, entitled 'Notes on some Sponges belonging to the Clionidæ, obtained at Madeira,' was taken as read, it being explained that, being chiefly descriptive of species, it would not be likely to interest the Meeting apart from the illustrations and references, although doubtless it would be a valuable addition to the communications published in the Journal for purposes of reference. Six slides of spicules, &c., in illustration of the paper were exhibited by the Society under Microscopes in the room.

The thanks of the Society were voted to Mr. Johnson for his paper.

There being no other paper on the Agenda, the President called the attention of the Fellows present to an exhibition by Mr. Beck of portions of various wild flowers shown with low powers under a number of Microscopes in the room, which he thought would be inspected with pleasure and interest. Many of them certainly made very pretty objects, and the Meeting was greatly indebted to Mr. Beck for bringing them down and showing them under so many instruments, which he had lent for the occasion.

The President reminded the Fellows that the Meeting would be adjourned for the customary summer vacation, and that their next Meeting would accordingly not take place until October 18th. He wished them all a very pleasant holiday, and hoped they would be able during the recess to find abundance of material for some good papers.

It was announced that the rooms of the Society would be closed from August 18th to September 18th.

New Fellows:—The following were elected *Ordinary Fellows*:—Mr. Walter Heasman, Dr. William J. Stevenson.

The Meeting then resolved itself into a Conversazione, at which the following Instruments, Objects, &c. were exhibited:—

The President:—An old 1/8 in. Objective, made by Andrew Ross; a New Coarse Adjustment.

The Society:—Six Slides illustrating Mr. Jas. Yate Johnson's paper.

Mr. Conrad Beck:—Exhibition of Wild Flowers under the Microscope.

Mr. Chas. Rousselet:—*Notops ruber.*

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

OCTOBER 1899.

TRANSACTIONS OF THE SOCIETY.

IX.—*Notes on some Sponges belonging to the Clionidæ obtained at Madeira.*

By James Yate Johnson, Corr. M.Z.S.

(*Read* 21*st June*, 1899.)

Plate VI.

The following five forms of boring Sponges were met with, at different times extending over a long series of years, in going over adhering masses of *Ostrea cochlear* and *Chama gryphoides*, as well as various corals brought up by the lines of the fishermen from deep water off the coast of Madeira. The sponges were all examined in the dry state. As they appear to be undescribed, I now give the result of my examination of them.

Acca * g. n.

Spicules of one form only, acerate.

1. *Acca insidiosa* sp. n., plate VI. figs. 1 and 1*a*.

Found upon shells of *Ostrea* and *Chama*, lining holes with round mouths about 1·5 mm. in diameter, and issuing as tubes from them. The walls of the tubes are composed of short acerate slender spicules,

EXPLANATION OF PLATE VI.

Fig. 1.—*Acca insidiosa*, part of the network of spicules over the end of a tube, and part of its wall, × 100. Fig. 1*a*, Spicule, × 200.
„ 2.—*Acca rodens*, part of the wall of a tube, × 200. Fig. 2*a*, Spicule, × 200.
„ 3.—Particles of coral produced by the action of *Acca rodens*, × 200.
„ 4.—*Acca infesta*, showing the arrangement of the spicules in the wall of a tube, × 100. Fig. 4*a*, Spicule, × 200.
„ 5.—*Scantilla spiralis*, fragment of a specimen with its acerate and spiral spicules, × 200. Fig. 5*a*, Spiral forms, × 300.
„ 6.—*Nisella verticillata*, spicules, × 200.

* Acca, Scantilla, and Nisa are female names to be found in the poetry or prose of ancient Rome.

crossing one another at all angles. In specimens mounted in balsam may be seen the dark sinuous bands of similar spicules arranged in bundles, but not forming a network. The tops of the tubes are covered over with a sieve-like reticulation formed of spicules in bundles. The spicules are short, cylindrical, acerate, slender, slightly curved. Colour of the sponge when dry, pale brown.

2. *Acca rodens* sp. n., plate VI. figs. 2 and 2*a*.

Found in a cavity in the stem of a coral (*Dendrophyllia ramea*). It is closely allied to the preceding species, but is apparently distinct. The entrance to the cavity is a round hole about 1 mm. in diameter, and from it projects a ring wall of sponge. The spicules are short, slender, acerate, curved, are more slender than those of the last species, and the bend at the middle is angular. They are densely matted together at all angles.

From the same cavity was extracted a quantity of minute particles, both rounded and angular, like fine sand, apparently produced by the gnawing action of the sponge on the coral. Some of these particles are represented on pl. VI. fig. 3.

3. *Acca infesta* sp. n., plate VI. figs. 4 and 4*a*.

Found upon shells attached to a sponge. It forms a cylindrical but somewhat contorted tube, about 1 mm. in diameter and from 2 to 6 mm. long, issuing from round cavities in the shell. The sides of the tube are composed of short curved acerate spicules in two layers, in one of which the spicules are placed close together side by side, and in the other they are laid transversely to those of the first layer, but in an irregular manner, and not close together, nor in bundles. The upper end of the tube is covered over by a reticulation of spicules arranged in bundles. The spicules are shorter and stouter than those of the two preceding species.

When fresh from the sea this sponge has a pale yellow colour. Placed in fresh water it threw off much clear slimy matter.

SCANTILLA g. n.

Spicules of two forms, viz. acerate, and undulating cylindrical rods.

Scantilla spiralis sp. n., plate VI. figs. 5 and 5*a*.

Pale brown, found in cavities about 1·5 mm. in diameter in shell of *Ostrea cochlear* from the coral zone. The spicules are of two forms:—(1) acerate, slender, slightly curved, the shorter ones lying in all directions irregularly; the longer ones are laid in bundles, which are sinuously consecutive, but do not form a network; (2) slender, cylindrical smooth loosely spiral rods of two or three turns, with the ends blunt or rounded. These are abundant.

NISELLA g. n.

Spicules of two forms, viz. a slender shaft with six long rays at the middle, and a fusiform shaft with two whorls of three short rays at the middle.

Nisella verticillata sp. n., plate VI. fig. 6.

A specimen of the alcyonarian coral *Pleurocorallium johnsoni* (Gray) had the solid stony stem broken away from the base, and the fracture crossed several small cavities, unconnected with each other. Out of these were picked fragments of a dark brown sponge of close texture with the spicules placed irregularly in all directions. When treated with nitric acid it yielded two interesting forms of spicule. The most abundant is normally a slender straight shaft, from the middle of which radiate six equally slender arms, which are half as long as the shaft, so that the whole forms an eight-rayed star. The arms and the two halves of the shaft taper slightly, and the ends are knobbed. There is, however, a good deal of irregularity in the position of the arms. Sometimes they are arranged in a spiral manner, and sometimes there are two whorls of three rays each. The second form of spicule is a fusiform shaft with two whorls of three short rays each at the middle. The shaft is roughened or finely ringed, and its ends as well as the ends of the rays are knobbed. The latter form of spicule connects this species of sponge with Carter's *Alectona Millari*,* in which a fusiform spicule is found with two rings, each of three tubercles at the middle in place of two whorls of rays, along with acerate spicules.

In a small dark brown sponge, picked out of cavities in the stem of another coral (*Dendrophyllia ramea*) not only were the two forms above described abundant, but a third form of spicule was sparingly present, viz. a slightly curved fusiformi-acerate shaft more than twice as long as No. 2 with an annular swelling at the middle. This may have been an intruder.

The soft parts of *Nisella verticillata* seem under some circumstances to be transformed into a hard structureless homogeneous cake of a dark brown colour. Such a cake is compact enough to crack across when drying after immersion in water. Imbedded quite irregularly in one mass of this kind, not only the forms of spicule Nos. 1 and 2 above described were found, but also (*a*) numerous slender forcipes, (*b*) stout spinulose spikes tapering from the truncate end to the other, (*c*) bihamate C-shaped, with simple acute ends, (*d*) smaller two-pronged bihamate or equi-anchorate. All these must be considered as belonging to other sponges.

* Journ. R. Micr. Soc., ii (1879) p. 497, pl. xvii.

OBITUARY.

Count Abbé F. Castracane.

By the death of Count Castracane, Hon. F.R.M.S., a well-known figure disappears from the scientific world. Francesco Castracane degli Antelminelli, a member of an ancient and noble Italian family, with traditions going back for some fifteen centuries—and one of whose ancestors was the celebrated warrior-poet Castruccio Castracane, who fought under our King Edward I.—was born at Fano, on the Adriatic coast, in 1817. At the age of twenty-three he took priest's orders, and entered on a life which was divided between the duties of his profession and the study of science. Possessed of ample means, he was able to gratify his love of learning without detriment to numerous beneficent schemes on behalf of the necessitous poor with whom his sacred office brought him into intimate contact.

His first scientific work was in connection with photography, an art then in its infancy, and later he turned to micrographic studies, particularly in relation to diatomology, and to improvements in the Microscope and its appliances. In 1867 he was elected to the Pontifical Academy of the Nuovo Lincei, of which he became President in 1880, and was made an honorary member of learned societies in most of the chief countries of Europe. The eminence Castracane attained as a diatomist was proved by his being entrusted with the material collected by the 'Challenger,' on which, after considerable delay from one cause or another, he reported in a volume of 170 pp. and thirty plates, forming Botany, vol. ii., of the 'Scientific Results' of the Expedition. Some 200 new species and several new genera were therein described; but some of these have now been withdrawn or revised, with his entire concurrence, as there was nothing of the infallible professor about Castracane. He died in Rome on March 27th last. As his friend De Toni writes:—"Science loses in Francesco Castracane an active member, humanity a noble heart."

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Inversion of Germinal Layers in Mammals.—Prof. Hubrecht ‡ briefly criticises Prof. Selenka's § statement that inversion occurs in apes, in a degree at all comparable to that seen in *Cavia*, *Sorex*, and *Pteropus*. The condition figured by Selenka is due to the fact that in the apes the amnion is completed early, and the germinal disc and umbilical vesicle are suspended to the outer blastocyst wall by a double sheet of ectoderm and somatic mesoblast. If this be inversion, then the term must be applied to all Sauropsida and Mammals at the stage when the stalk of the amnion is constricted off. In a postscript to his paper Hubrecht considers Selenka's revised definition, and his view that germinal inversion is to be explained on mechanical grounds, as the result of want of space, which forces the embryonic ectoderm, plus the ectodermic part of the amnion, to sink inwards. Hubrecht advances three arguments against this position. In the first place, such an insinking of embryonic ectoderm occurs in *Tupaia*, while the blastocyst lies as free in the cavity of the uterus as does the unfolded blastocyst of the rabbit. Secondly, in the hedgehog the blastocyst early becomes fixed to the wall of the uterus, and is limited on all sides, but yet displays no "inversion" worthy of the name. Thirdly, in *Sorex*, where inversion is so distinct, this does not occur until after the uterus has become so much inflated that there can be no lack of space. He believes further that the origin of the amnion from folds, which is typical for the oviparous Amniota, is not primitive for Mammals, and that the cases of inversion found in Rodents, Bats, and Primates are not cænogenetic phenomena, but are palingenetic.

* 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, &c., 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 and Reproduction, and allied subjects.

‡ Biol. Centralbl., xix. (1899) pp. 171–5. § Cf. this Journal, *ante*, p. 17.

Prof. Selenka * briefly replies to the foregoing. He uses the term inversion to mean that sinking-in of the embryonic ectoderm into the interior of the germinal vesicle during gastrulation which produces a temporary reversal of the position of the two layers, and considers this use of the term as quite legitimate. The causes of the phenomenon may be various, and the described cases are not all due to the same cause. The method of formation of amnion, umbilical vesicle, and allantois, varies greatly, and is determined by the method and time of the fixation of the embryo; the determination seems to him to be the result of mechanical causes.

Influence of Cold on Frog's Ova.† — Prof. O. Schultze has made fresh experiments on the influence of low temperature on the development of the frog, and some of his results modify his previous conclusions.

A freshly fertilised ovum of *Rana fusca* was injured by a temperature of 0°, but no state of quiescence due to cold (*Kälteruhe*) was brought about.

Ova at the blastula stage were subjected for five weeks to a temperature between zero and 1°, the development proceeded with extreme slowness to the gastrula stage, but after normal temperature was restored normal larvæ resulted.

Prof. Schultze proceeded to experiment with gastrula stages which he subjected to a temperature of about zero. The development proceeded slowly (from April 18th to May 1st). Thereafter they were removed to the temperature of the room, and the result was four normal tadpoles, three malformations, and two dead eggs. Thus even in the gastrula stage development may go on at zero. It seems probable that in this case stoppage would mean death. In any case, the fact is that no thorough cessation of cell-division could be demonstrated.

Behaviour of Nucleolus during Development of Eggs.‡— Herr Paul Obst has studied the changes exhibited by the nucleolus in developing eggs of some Molluscs and Arachnoids. He finds that in all the eggs examined, with the possible exception of those of *Tegenaria domestica*, two kinds of nucleolar substance appear during the process of development of the unripe eggs. The one (cyanophil) is the paranuclein of O. Hertwig, and occurs at all stages of development. It is probably of more importance than the other (erythrophil), which appears later, and at very different periods in the various animals examined. The origin of the cyanophil is difficult to determine, but it seems to originate by the fusion of minute specks which appear in the nucleus. The cyanophil nucleoli seem to increase by taking up the erythrophil; this is seen very distinctly in *Epeira diademata*. The author has no suggestion to offer as to the use of the two kinds of nucleolar substance. The fate of the nucleolus during maturation was studied in eggs of *Limax maximus*, but the eggs were not double-stained. It was found that during the formation of the first spindle the nucleolus became vacuolated. Later the vacuoles coalesced to form one very large vacuole, the process being apparently a stage in the disappearance

* Op. cit., xix. (1899) pp. 175–6. † Anat. Anzeig., xvi. (1899) pp. 144–52.
‡ Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 161–213 (2 pls. and 5 figs.).

of the nucleolus. At the time of the formation of the second spindle it had entirely disappeared.

Centrosome and Fertilisation.*—M. Félix Le Dantec has a brief note on this subject. He believes that the reaction which followed the disproof of Fol's "quadrille of the centres," has induced embryologists too hastily to accept the position of Boveri that the centrosome of the fertilised egg is that introduced by the sperm. If centrosome be defined as a specialised portion of protoplasm within an aster, then the centrosome is absent alike from mature ovum and from sperm. If, on the other hand, the word be used to designate a portion of protoplasm capable of producing an aster, then, although such specialised protoplasm can be demonstrated only in the sperm, may it not exist in diffuse condition also in the ovum? The phenomenon of fertilisation might then be explained in the following way. The sperm, in addition to the male pronucleus, contains a mass of male protoplasm (the so-called centrosome or spermocentre), while the ovum contains diffuse female protoplasm (diffuse centrosome or ovocentre) in addition to the female pronucleus. The male protoplasm exercises upon the female an attraction similar to that which the nuclei exercise upon one another, and round the two the aster forms (centrosome of fertilised egg). Thus there is a protoplasmic fertilisation as well as a nuclear one. This suggestion is in essence similar to Fol's theory apart from the appearance described by him, and the author believes that it is not only in as perfect harmony with the facts of observation as that of Boveri, but that it explains Delage's experiments on the fertilisation of non-nucleated eggs.

Centrosome and Periplast.†—Professors Vejdovsky and Mrazek publish a preliminary note on their researches on this subject. The former author, in his observations on the process of fertilisation carried on twelve years ago, used eggs of *Rhynchelmis*, which he regards as exceptionally favourable material. Until quite recently he has been unable to procure more material; but, having succeeded, he now finds that his results, in spite of new methods, are the same as his previous ones. The authors find that centrosome and periplast (attraction-sphere) are constant organs of the cell, and that the centrosome always lies within the periplast. The periplast of the next division arises endogenously within the previous sphere. The rays also are new formations arising from the reticulum of the previous periplast. As to the origin of the periplast, the authors think there is no doubt that it arises from the specialised cytoplasm contained in the middle piece of the sperm.

Structure and Development of the Spermatozoa in the Guinea-pig.‡—Dr. F. Meves has made a very exhaustive series of observations on this subject. He finds that after the last maturation division, the spermatides contain a large central nucleus, an idiozome or sphere containing numerous corpuscles staining darkly with iron-hæmatoxylin, two central corpuscles outside the sphere, and finally some chromatoid bodies showing the staining reactions of nucleoli. During the first

* Comptes Rendus, cxxviii. (1899) pp. 1341–3.
† SB. Böhmisch. Ges., 1898, pp. 3–11 (6 figs.).
‡ Arch. Mikr. Anat., liv. (1899) pp. 329–402 (3 pls. and 16 figs.).

period of development the nucleus becomes excentric, and the corpuscles of the idiozome increase in number and size, and ultimately fuse together to form a little vesicle enclosing a single large granule. The vesicle lies within the idiozome. The idiozome then approaches the nucleus and its vesicle begins to flatten out until it ultimately envelopes the nucleus like a cap; the remainder of the idiozome meanwhile retreats into the cytoplasm. The nuclear cap later becomes the cap of the head of the spermatozoon. While these changes have been going on, the cell periphery has grown out into a slender thread, the rudiment of the future tail. With this thread the distal central corpuscle is intimately connected. The two central corpuscles then travel inwards towards the nucleus, the axial thread travelling inwards with the distal one. At this stage the nucleus with its cap projects from the surface of the cell-substance, and from the cell-substance a series of fine threads are differentiated, which surround the central corpuscles and the axial thread like a basketwork. Later these threads become shorter and thicker, and ultimately unite to form a membrane. The membrane becomes converted into a tube which envelopes the tail and constitutes the peculiar tail appendage. A little later this disappears in the cytoplasm, and the cytoplasm shrivels up to form a ball which is cast off by the spermatozoon. The changes undergone by the central corpuscles are exceedingly complicated, and cannot be rendered intelligible without figures; one point of special importance is that a part of the distal centrosome forms a ring round the axial thread, the ring disappearing before the spermatozoa reach their full development.

The second part of the paper consists of a critical comparison of the observations of the author and of others on the development of the sperms of different animals. As to the part played by the central corpuscles, the author believes that their chief function is to connect the motile tail with the head, and that both in cell-division and in the sperm they play the same part in acting as points of origin for motile threads (cf. the movements of the chromosomes in mitosis). He believes further that their variations in different animals will be found to be intimately connected with the particular form of the sperm. He does not believe that the central corpuscles act as centres of force.

Development of Spermatozoa.*—Dr. J. Nusbaum has investigated the process of conversion of the spermatide into the spermatozoon in *Helix lutescens* Ziegl. He finds that the spermatide contains two centrosomes, a proximal and a distal, and that the relation of the parts of the spermatide to those of the spermatozoon is as follows:—The head of the spermatozoon arises from the nuclear chromatin of the spermatide, the pointed portion of the head arising from the nuclear corpuscles; the axis of the middle piece of the sperm arises from the proximal centrosome, while the envelope of this axis arises from the nuclear fluid (karyoparamitome); the axial filament of the tail arises from the distal centrosome and from the cytoplasm (mitome), while its envelope arises from the cytoplasm alone.

Origin of Spermatozoa.†—Dr. K. v. Korff gives an account of the development of the sperms of *Helix pomatia* which, so far as it goes, is

* Anat. Anzeig., xvi. (1899) pp. 171–80 (7 figs.).
† Arch. Mikr. Anat., liv. (1899) pp. 291–6 (1 pl.).

similar to that given by Nusbaum for *H. lutescens*. At an early stage Korff finds three centrosomes in the spermatides, but one of these disappears, leaving a proximal and a distal. He describes the elongation of the proximal centrosome, and its conversion into the axial filament of the middle piece of the sperm, but was not able to follow the changes of the distal centrosome beyond the early stages. His paper and that of Nusbaum seem to have been published almost simultaneously.

Factors in Morphogenesis.*—Dr. O. L. Zur Strassen discusses the possible formative factors in development, and concludes that too much importance is attached by O. Hertwig and others to the environmental influences. The really determinative factor is in the fine internal mechanism. "It is as if the segmentation-cell had a guiding instinct." This is illustrated by cases where the blastomeres move spontaneously but definitely. Tensions and pressures are insufficient to explain the changes of form and the cytotropic wanderings.

Development of the Common Phalanger.†—Dr. R. Broom has made some observations on the breeding habits and the development of *Trichosurus vulpecula*. Only one young is produced at a time, and the breeding season varies a little, but usually begins in March. The young begin to breed when about a year old. No trace of an allantoic placenta could be found. The paper includes descriptions and figures of several young stages both intra-uterine and mammary.

Development of Siphonops annulatus.‡—Dr. Emil A. Göldi communicates a brief note on a discovery of the eggs of this Amphibian in the Orgel Mountains, Rio de Janeiro. The mother and eggs were found in a very dry situation. The former was coiled round the string of eggs, which were six in number. They were perfectly transparent, and in size 10 mm. by 8½ mm. They contained well-developed embryos, in appearance very similar to those of *Epicrium glutinosum*. The fact that breeding takes place in dry situations is of interest in view of the fact that the gills of the embryo are very well developed.

Development of Snake's Poison-gland.§—Dr. H. Martin has studied this in an embryo of *Vipera aspis*. It begins as a single bud, which divides on the one side into a bud growing towards the fang-apparatus, and on the other side into a venom-rudiment. The latter gives rise to three structures, namely, in order of their appearance,—a Y-shaped organ (*gaîne gingivale*), a poison-canal, and the poison-gland. The embryonic development of the parts occurs in an order the opposite of that of the venom-flow in the adult.

Lateral Sense-organs of Fishes.‖—Mr. F. J. Cole has studied this subject with special reference to the genus *Gadus*. He finds that the sensory canal system of all fishes can be reduced to a common type. This type includes a lateral canal on the body, one canal over the eye and another beneath it, and one related to the lower jaw. All these

* Verh. Zool. Ges. Heidelberg, 1898, pp. 142–56 (10 figs.). See Zool. Centralbl., vi. (1899) pp. 400–2.
† Proc. Linn. Soc. N.S.W., xxiii. (1898) pp. 705–29 (4 pls.).
‡ Zool. Jahrb. (Abth. Syst.), xii. (1899) pp. 170–3 (1 pl.).
§ Bull. Soc. Zool. France, xxiv. (1899) pp. 106–16 (13 figs.).
‖ Trans. Linn. Soc., vii. (1898) pp. 115–221 (3 pls.).

canals may be connected by median commissures with their fellows of the opposite side. In *Gadus* the canals have only diverged slightly from the typical form, the sense-organs are somewhat reduced, and Savian organs and Lorenzini's ampullæ are absent. The lateral line system of Fishes is not metameric, and the nerves supplying the lateral sense-organs form a separate series in themselves and are not connected with any of the other cranial nerves. The so-called lateralis nerve of *Petromyzon* is not a lateral line nerve at all, but belongs to the *lateralis accessorius* system. The lateral line sense-organs of Fishes and Amphibia are not homologous with the lateral sense-organs of Annelids. The sensory canals were probably represented in the ancestral Vertebrates by superficial non-segmental sense-organs. These, together with certain lateral glandular organs, sank below the surface, and fused to form canals filled by mucus secreted by the glandular organs. These glandular organs have become reduced in importance, and their function is now to secrete a substance corresponding to the endolymph of the ear. The primitive sensory canal system was probably confined to the region now occupied by the ear, and it gave rise alike to the existing lateral line system and to the auditory organs. The author believes that the semicircular canals of the ear are homoplastic and not homologous with the sensory canals.

Absence of Parietal Eye in Myxine.* — Herr F. R. Studnicka publishes a short note on this subject. He quotes various authors to show the difference of opinion which exists as to the presence or absence of the pineal eye in the hag. Thus Beard describes it in one specimen among many examined, while Leydig doubtfully notes a structure which may be a true pineal gland or else a lymph-sac. The author himself finds that the parietal organ is entirely absent; the structure described by Beard is the infundibular prolongation of the thalamencephalon; that described by Leydig is not a part of the brain but probably an enlarged lymph-sac. In the total absence of the parietal organ, the brain of *Myxine* is contrasted with that of *Petromyzon*, where there is a distinct pineal eye at the end of a well-developed epiphysis.

Relation of Yolk-elements to the Blastoderm-Cells.† — Prof. M. Lavdowsky and Dr. N. Tischutkin have studied this problem in chick embryos, and their general conclusion is that the elements of the white yolk, which the authors call *Dottercyten*, are the main elements for the three germinal layers, in fact that these cytode-like bodies of the yolk furnish all the subsequent nucleated cells of the blastoderm. The chief or primitive layer of the blastoderm is the upper multicellular layer, which is a veritable "archiblast," to use the term proposed by His. The *Dottercyten* are derivatives of the yellow yolk, arising from characteristic clumps—the yolk-segments—whose rich proteid substance furnishes chromatin. There are no sharp microscopic or physiological differences between the two kinds of yolk. Although the authors do not wish to run a tilt against Virchow's conclusion "*omnis cellula e cellula*," nor against its modern corollary "*omnis nucleus e nucleo*," they maintain that cell-development and cell-multiplication may occur in several distinct ways, including that above indicated.

* SB. Böhmisch. Ges. Wiss., 1898, pp. 1–4.
† Biol. Centralbl., xix. (1899) pp. 411–21.

Origin of Endocardial Epithelium in Salmon.*—Dr. B. Nöldeke has studied embryos of *Salmo salar* with reference to this question. He finds that the "heart-cells" of Ziegler are at least in part formed by the endoderm, but the absence of a distinct demarcation between mesoderm and endoderm in the region of origin makes it impossible to determine what part the two layers take in the process. He considers that the common statement that the endothelium of the heart arises wholly from mesoblast is entirely opposed to the conditions actually seen in the salmon.

Sex of Hybrids.†—M. Henri Gadeau de Kerville calls attention to the fact that the results of successful hybridisation are much oftener males than females, and that male offspring are more numerous in proportion to the specific distance between the two parents. He regards this as supporting the position held in regard to the determination of sex by Messrs. Geddes and Thomson in their 'Evolution of Sex.'

b. Histology.

Practical Cytology.‡—Dr. V. Hæcker has produced a very useful introduction to cytology in the form of a series of practical lessons on the cell, the nucleus, karyokinesis, the ovum, the spermatozoon, maturation, fertilisation, and the like. His experience in conducting such a course for many years has made him aware of the material best suited for class purposes, and the results of this experience are now made available to other teachers. Each lesson gives an account of the methods regarded as most effective, and a description of the selected objects; the theoretical and historical aspects of the subject are also briefly alluded to. A carefully selected set of figures and references increases the value of the book, which impresses one as a very satisfactory piece of work. It will be of much service to teachers of histology and to private students.

Experiments on the Regenerative Capacity of Striped Muscle.§—Prof. B. Morpurgo carefully removed a strip of muscle from the fore-limb of newly born white rats, and, by making an estimate of the number of fibres:—(*a*) in the excised bundle; (*b*) in the muscle operated upon, after an interval of two months; and (*c*) in a normal muscle; reached the conclusion that the young muscle-tissue (whose elements were still multiplying by karyokinesis) has not the power of regenerating a lost strip.

Longitudinal Growth of Striped Muscle.‖—Prof. B. Morpurgo finds that the distribution of the nuclei in the fibres of a muscle which has not attained its full length is exactly the same as that in the fibres of the full-grown muscle. The number of nuclei is strictly proportional to the growth in length. A new formation of muscle-nuclei continues in extra-uterine life long after the mitoses have ceased, so that the mode of multiplication is doubtless amitotic.

* Zeitschr. f. wiss. Zool., lxv. (1899) pp. 517–28 (1 pl.).
† Bull. Soc. Zool. France, xxiv. (1899) pp. 49–51.
‡ 'Praxis und Theorie der Zellen- und Befruchtungs-lehre,' Jena, 8vo, 1899, viii. and 260 pp. and 137 figs.
§ Anat. Anzeig., xvi. (1899) pp. 152–6. ‖ Tem. cit., pp. 88–91.

Structure of Unstriped Muscle.* — Herr Josef Schaffer has made an exhaustive series of observations on this subject, with a special view to determining the relations of the cells, and the presence or absence of the "intercellular bridges" of Kultschitzky. He began his investigation with fresh preparations from the umbilical cord, gut, and urino-genital tract of man and domestic animals. Such preparations showed the existence of a partly fibrous connective tissue between the muscle-cells containing formed elements. The margins of the muscle-cells were perfectly smooth, and the appearance of transverse bridges across the cells was due to folds in the connective tissue or to fibrous structures. A series of experiments with fixing reagents then showed that these alter greatly the appearance of the cells, and that the same reagent does not necessarily act alike upon all muscle preparations. Usually the effect of the reagents is to make the smooth contour of the cell appear toothed. In studying sections, allowance must be made for such changes of structure; and the stains employed should differentiate between muscle-cells and connective tissue. A mixture of picric acid and acid fuchsin was found to do this. A comparison of numerous preparations stained in this way showed that a delicate perforated sheet of connective tissue exists between the muscle-fibrils. This has really a foam-like structure, but in optical section appears like a network of fibres. The "intercellular bridges" of Kultschitzky and Barfurth are artificial products due to the rupture of this intercellular connective tissue. This result explains the contradictory results obtained by various authors as to the presence or absence of "intercellular bridges" in the unstriped muscles of different animals.

Intercellular Connections and Cell Prolongations.† — Herr F. K. Studnicka publishes an elaborate paper on the relations between the two kinds of cell prolongations, those which project from the free surface of the cells (cilia, striated membranes), and those which connect adjacent cells (intercellular bridges, &c.). He endeavours to prove that such a relation exists by an exhaustive comparison of the results obtained by himself and others from the investigation of the two kinds of structure. Intercellular bridges are those prolongations which connect the adjacent cells of epithelia, notochordal tissue, &c., by bridging over the intercellular spaces. The bridges are sometimes filiform and at other times lamelliform, and are either smooth or furnished with little swellings. The author then describes in detail the intercellular structures found in epithelia, in unstriped muscle, in connective tissue, and in cartilage. As to the meaning of the intercellular spaces, the author notes that they are present in epithelia, in notochordal tissue, and in unstriped muscle (but cf. Schaffer above), except in young cells or where a matrix occurs between the cells. They communicate with the lymphatic system, and probably serve to nourish the cells. The intercellular bridges are elastic and are capable of contraction and expansion, they are plasmic and so at least primitively connect the plasm of adjacent cells, but in some cases they originate from the hardened exoplasm of the cell and appear to be quite passive. Their existence is not therefore an argument against the cell theory.

* Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 214–68 (2 pls.).
† SB. Böhmisch. Ges. Wiss., 1898, pp. 1–66 (1 fig.).

As to the structure of the free surfaces of cells, the striated marginal layer found in epithelial cells has often been regarded as cuticular in structure, but according to the author it is in origin and structure similar to typical intercellular connections, and is merely exposed by the death of the outer cell with which its intercellular bridges were once connected. The cilia of ciliated epithelial cells have already been homologised with the striated layer of non-ciliated cells, so that the possibility of comparing them with intercellular connections naturally follows from the above. It is of special importance to note that at their bases little swellings occur comparable to the swellings on the rods of the striated layer and to the similar structures on the intercellular bridges. The author believes that cilia are at least in part equivalent to the rods of the striated layer, and that this striated layer shows much resemblance to the intercellular structures.

Mammalian Epidermis.*—Prof. L. Ranvier maintains that seven distinct layers should be recognised in the epidermis of man and mammals. Following the developmental order, he calls these *stratum germinativum*, *filamentosum*, *granulosum*, *intermedium*, *lucidum*, *corneum*, and *disjunctum*. Each has distinct physical characters and chemical reactions, and the limits are well defined. But it must not be supposed that these layers are formed by special elements. A cell originating in the *s. germinativum* changes its character and passes into the *s. filamentosum*, and so on, "as if knowing what to do and doing it."

Ganglion-cells of Spinal Cord.†—Dr. Emil Holmgren publishes a preliminary note of his researches on this subject, confining himself to some conditions found in the rabbit and the frog. In the rabbit he has found a network of fine tubes ramifying through the cell, which he believes to be identical with the fibrillar network described by Golgi in the rabbit and the cat. He does not believe that these tubes carry blood, and has succeeded in demonstrating true intracellular capillaries in the same cells. The method employed was to fix in sublimate containing picric acid and to stain with toluidin-erythrosin.

As to the ganglion-cells of the frog, serial sections seemed to cast light on the "microcentra" described by Lenhossek. They showed that the "microcentra" and the "centrosphere" are appearances presented by sections through a spiral figure imbedded in the cell-protoplasm. The spiral figure consists of coils certainly formed of differentiated cytoplasm, between which lie fibrils having the staining reactions of the capsular structure which surrounds the proximal part of the axial cylinder. By treating the ganglia with salicylic alcohol and staining with iron hæmatoxylin combined with acid fuchsin, orange, or rubin, it can be clearly shown that these fibrils are spirally coiled nerve-fibrils which penetrate into the cells.

Neurites in the Central Nervous System.‡—Dr. Semi Meyer has used toluidin-blue instead of methylen-blue for the study of nerve-cells, and finds that although essentially similar in its action, it in some cases gives clearer figures. He has also used methylen-blue with Bethe's

* Comptes Rendus, cxxviii. (1899) pp. 67–70.
† Anat. Anzeig., xvi. (1899) pp. 161–71 (11 figs.).
‡ Arch. f. Mikr. Anat., liv. (1899) pp. 296–311 (1 pl.).

method of fixation. His results show that the connection of the neurones is much closer and more complicated than has been supposed. The whole surface of the protoplasmic part of a nerve-cell can receive stimuli from neurites which either form a trelliswork over the surface of the cell, or end on its surface in cup-shaped swellings. Both kinds of ending may occur on the same cell.

Structure of Capillaries.* — Dr. Sigmund Meyer discusses the so-called "star-cells" (Kupffer's cells) found in the liver. These were first described by von Kupffer as perivascular structures, but later he regarded them as the modified endothelium of the hepatic capillaries, specially characterised by their phagocytic importance. The author gives a detailed account of the researches made on the capillaries of the liver and of other organs, with the object of showing that the capillary walls display great modifications of structure in different parts of the body, the modifications having a special relation to the composition of the tissue or organ in which the capillaries occur. Observations, both in physiological and pathological conditions, seem to show further that the extent to which diapedesis, both of formed and unformed elements, may occur can vary rapidly, either through the direct influence of the surrounding fluid or through the influence of the nervous system. The fact of these changes may help to account for the very varying results obtained by different authors in regard to the capillaries of the same organ.

Histology of Alimentary Canal in Dasypus villosus.†—Herr Konrad Koloman Helly obtained the alimentary canal of a specimen of this Edentate, and studied its structure in detail. The gullet is smooth-walled and has a thick muscular investment. The glands are very well developed, and are mucous glands of the usual type resembling those of the dog. The *muscularis mucosæ* is remarkable, because both the outer longitudinal layer and the inner circular layer consist of a mixture of striped and unstriped fibres arranged after a fashion not yet described elsewhere. The histology of the other parts of the alimentary tract shows no special peculiarities.

Teeth of Fossil Dipnoi.‡— Prof. J. v. Rohon has investigated the structure of the teeth in some Upper Silurian Dipnoi, and finds that the dentine shows a hitherto undescribed modification. The teeth consist chiefly of vasodentine which resembles the corpuscles of bone very closely. The resemblance is such that it can only be explained on the supposition that odontoblasts and osteoblasts were functional at the same time, so that neither true dentine nor true bone was differentiated, but a skeletal substance without parallel among the hard tissues of Vertebrates.

Luminous Organs of Fishes.§—Sigg. P. Chiarini and M. Gatti distinguish two main kinds—electrical and glandular—and describe the minute structure of the latter in the present paper. The glandular luminous organs are found in all the Sternoptychidæ and Stomiatidæ which the investigators have examined, and in *Porichthys porosissimus*;

* Anat. Anzeig., xvi. (1899) pp. 180–92.
† Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 391–403 (1 pl.).
‡ SB. Böhmisch. Ges. Wiss., 1898, pp. 1–18 (1 pl.).
§ Atti R. Accad. Lincei (Rend.), viii. (1899) pp. 551–6.

they consist of a pigmented envelope, a silvery layer, a sheath of connective tissue, and a central body.

c. General.

Origin of Fauna of Celebes.*—Prof. Max Weber, in the course of a description of the fresh-water fishes of the Malay Archipelago, discusses this question. He shows that Celebes has relatively very few fresh-water fishes, but those which are present are Indian and not Australian in their characters. The poverty of the fauna cannot be explained by the present condition of the island, and the author believes that it is due to the fact that, until geologically recent times, Celebes consisted of a number of small islands. According to the author, the Mammalian fauna has also much more of an impoverished Indian than of an Australian character. This is true also of the other islands, and no sharp boundary line exists between Bali and Lombok. East of Celebes and Flores we come first into a distinct transition region between the Indian and Australian regions; "Wallace's line" does not therefore separate these regions.

Bipolarity of Marine Faunas.†—Dr. A. E. Ortmann returns to a discussion of the contention of Pfeffer and Murray that bipolarity forms a very striking feature of the polar faunas. This has been denied by Ortmann with regard to the decapod crustaceans, by von Ihering for molluscs, by Breitfuss for Calcispongiæ, by Herdman for tunicates, by D'Arcy Thompson for fishes, isopods, and amphipods, by Ludwig for holothurians, crinoids, and ophiuroids, by Bürger for nemertines, and by Chun for the entire bulk of the pelagic fauna. Four cases of true bipolarity are admitted, which are to be explained by some theory.

In all other cases the supposed bipolar range of a species or group has been connected by intermediate localities, either (*a*) along the bottom of the deep sea or in deeper strata of the tropical parts of the open sea, or (*b*) along the western shores of the continents, mostly connected with a descending of the respective forms into deeper water.

"It is possible that by these ways cases of true bipolarity may develop, provided these connections become discontinued. The writer has explained a true case of bipolarity (*Crangon*) by one of these ways. But, on the other hand, it is possible that bipolarity is to be explained by the Pfeffer-Murray theory in some cases by former conditions of the earth's history, especially those existing at the beginning of the Tertiary period. Yet we do not know any concrete case of this kind, and we must wait for further investigation to show whether bipolarity as a relic of older times is realised in the geographical distribution of any marine animals."

What is Life? ‡—Prof. F. E. Weiss, in his Presidential Address to the Manchester Microscopical Society, discusses the phenomena of life with special reference to the doctrine of "vital force." He regards the power of assimilation and the power of movement as the two main

* Ann. and Mag. Nat. Hist., iii. (1899) pp. 121–36. Trans. from Zool. Ergeb. einer Reise in Niederländ. Ost-Indien, iii. (1894).
† Amer. Nat., xxxiii. (1899) pp. 583–91.
‡ Trans. Manchester Micr. Soc., 1898, pp. 64–76.

characteristics of living organisms, reproduction being regarded as the result of growth and assimilation rather than as a prime characteristic of living things. The theory of vital force has been recently urged from the chemical point of view by Prof. Japp, and from the physical by Mr. Alfred Earl. Prof. Weiss believes that chemists will ultimately succeed in producing organic substances having the asymmetry of natural products, and in the meantime does not regard the argument derived from chemistry as of great value.

Mr. Earl's biological argument is based upon the apparent existence of an element of choice in the movements and feeding of living organisms. As to the latter, Prof. Weiss points out that species of *Fucus* growing in similar conditions do not absorb similar amounts of potassium and calcium, so that two different vital forces must be at work even in plants so nearly allied. He believes that the progress of knowledge will show that what appears to be choice is merely the result of complex chemical processes. He believes, similarly, that the movements of animals and plants are due to mechanical, physical, and chemical changes in their protoplasm, and that the belief in a vital force tends rather to retard than to advance scientific progress.

Evolution of Scales of Lizards.*—Herr A. Sokolowsky has studied the scales of Lacertilia in connection with the probable phylogeny of the class. He comes to the conclusion that all the forms may be referred back to simple papillæ with radial growth, as seen in geckos. Vestiges of this primitive condition are still to be seen in forms with highly developed scales.

Osmotic Peculiarities of Cells.†—Herr E. Overton publishes a preliminary account of his investigations on this subject. By a series of experiments on root-hairs, he finds that those substances which are more soluble in ether, fatty oils, and similar media than in water, are capable of penetrating through living protoplasm with great rapidity, while those which are slightly or not at all soluble in ether and fatty oils, penetrate the protoplasm either very slowly or not at all. He believes that this is explicable only on the supposition that the superficial layer of protoplasm is impregnated with a substance having the solvent properties of a fatty oil. Various facts are against the supposition that the substance can be itself a fatty oil, and the author believes that it is cholesterin or a cholesterin compound, and that this explains the universal distribution of this substance. Such animal cells as possess vacuoles filled with cell-sap display the same plasmolytic phenomena as plant cells. The osmotic peculiarities of other animal cells were studied by placing amphibian tadpoles in various solutions. By a combination of observation and deduction the author convinced himself that their cells react in the same way as do plant cells. A remarkable circumstance with regard to Amphibians and certain fish, is that the epithelial cells are permeable to water in one direction only, that is, from within outwards, and not in the reverse direction, for the osmotic pressure of the blood is much higher than that of the surrounding water, and yet water does not pass into the blood system. Nevertheless, the author

* Zürich, 1899, 56 pp., 1 pl. See Zool. Centralbl., vi. (1899) pp. 415–8.
† Vierteljahrschr. Nat. Ges. Zürich, xliv. (1899) pp. 88–135.

does not consider it necessary to postulate a special vital action on the part of the cells, but thinks that there must be special mechanical peculiarities in the cells. He thinks that similar conditions must exist in certain glands where water passes from a solution of higher osmotic pressure to one of lower. The remainder of the paper consists of a discussion of the relation between the chemical composition of various drugs and reagents, and their physiological action.

Sense of Smell in Birds.*—Xavier Raspail has made observations which lead him to conclude that the sense of smell, which many authorities regard as practically undeveloped in birds, except in nocturnal birds of prey, is really well-developed in many, such as rook magpie, and blackbird, whose olfactory sensitiveness he compares with that of dogs.

Ear and Lateral Line in Fishes.† — Prof. F. S. Lee has made numerous experiments, especially on *Galeus canis*, as to the functions of the ear and the lateral line. The *cristæ acusticæ* are connected with the perception of rotatory movements; the *maculæ acusticæ* are connected with the perception of progressive movements and the position of the fish; the *papilla acustica basilaris* (the nerve-ending in the organ of Corti), present in higher Vertebrates, is absent in fishes, and with it the proper auditory nerve; the lateral line is associated with equilibration.

Affinities of Enterochromes.‡—Dr. Marion I. Newbigin points out that, while acid acts on an alcoholic extract of green leaves in such a way as to produce the pigment phyllocyanin, which is insoluble in alcohol and ether, its action on an alcoholic extract of green algæ results in the production of a pigment which is exceedingly soluble in alcohol, and does not therefore precipitate from acidified alcoholic solutions unless a considerable amount of water be added. In its colour and fluorescence, in its spectrum, in its changes in colour and spectrum on the addition of acid, in its solubilities, the pigment shows a remarkable resemblance to the enterochromes. This resemblance is such that, taken in conjunction with the recent observations and conclusions of Dr. McMunn in the case of "enterochlorophyll," and with the fact that that pigment occurs in the fæces of *Patella*, it seems to justify the conclusion that "enterochlorophyll" at least is an acid derivative of chlorophyll, produced by the action of the digestive juices on the chlorophyll of the food. Whether the other enterochromes, and notably chætopterin, are produced in this way, cannot yet be determined. There can, however, be no doubt that the enterochromes are at least closely related to the pigment produced by the action of acid on the chlorophyll of green algæ.

Functions of Lymph-glands in Vertebrates.§—Dr. V. Schumacher has investigated the lymph-glands of numerous monkeys and of men, and finds that they are areas in which red blood-corpuscles undergo degeneration. The leucocytes take up the corpuscles, and these then break down into pigment within the cytoplasm of the leucocytes. He

* Bull. Soc. Zool. France, xxiv. (1899) pp. 92–102.
† Amer. Journ. Physiol., i. (1898) pp. 128–44. See Zool. Centralbl., vi. (1899) pp. 409–11.
‡ Zool. Anzeig., xxii. (1899) pp. 325-8.
§ Arch. f. Mikr. Anat., liv. (1899) pp. 311–28 (1 pl.).

finds, further, that the leucocytes do not leave the glands by the lymphatics only, but that they may reach the blood stream directly by diapedesis through the walls of the veins.

Neomylodon.*—Herr E. Nordenskiöld has found some interesting remains in the caves at Ultima Esperanza (South Patagonia), from which two pieces of the skin of "*Neomylodon Listai*" were previously procured. He thinks that the bones he has found, which he promises to describe, probably belonged to *Neomylodon*, and that this somewhat shadowy creature was exterminated by some big extinct carnivore, or perhaps by the puma.

Position of Edentata.†—Dr. G. Elliot Smith has made an elaborate study of the brains of Edentates, and includes in his memoir a discussion of the affinities of this heterogeneous order, as suggested by the anatomy of the brain. He does not find that the brain is of the simple and low type which has been supposed. The brain of *Orycteropus* in many respects recalls the brain of a simple Ungulate, and the author is of opinion that this form is to be regarded as an early offshoot from the root-stock of the Ungulata or Condylarthra. The position of *Manis* is more doubtful, but it probably diverged from the primitive stock about the same time as the ancestors of the Ungulates. In the American Edentates the brain shows affinities, on one hand, with the Carnivora, and on the other with the Rodents, and the author believes that they are an offshoot from the stock which gave rise to these two orders. The paper includes some interesting observations on brain development in mammals.

Affinities of Ornithorhynchus.‡—Dr. V. Sixta gives a detailed comparison of the pectoral girdles of *Ornithorhynchus paradoxus* and *Uromastix spinifer*, pointing out that the skeletal resemblance is so strong that even an experienced zoologist might mistake an isolated pectoral girdle of the duckmole for that of a lizard. In the embryological data as to the development of the girdle in *Ornithorhynchus*, the author finds corroboration of "the beautiful biological law:—Ontogeny is an abbreviated recapitulation of phylogeny."

INVERTEBRATA.

Mollusca.

Gastric Gland of Mollusca and Decapod Crustacea.§—Dr. C. A. MacMunn has investigated the structure and functions of this gland, with special reference to the nature and origin of the pigment enterochlorophyll. His conclusions are that the pigment is a derivative of chlorophyll, which is taken up from the intestine, dissolved in a fatty medium, and is excreted into the tubules of the gastric gland by means of the gland-cells.

Shell-making and the Origin of the Dark Pigment.‖—Dr. G Steinmann returns to a subject on which he threw some light about ten

* Zool. Anzeig., xxii. (1899) pp. 335–6.
† Trans. Linn. Soc. (Zool.), vii. (1899) pp. 279–394 (36 figs.).
‡ Zool. Anzeig., xxii. (1899) pp. 329–35.
§ Proc. Roy. Soc. London, lxiv. (1899) pp. 436–9 (Abstract).
‖ Ber. Nat. Ges. Freiburg i. Br., xi. (1899) pp. 40–5.

years ago. Proteid material produced by the mollusc is decomposed by bacteria, forming on the one hand carbon dioxide and ammonia, and on the other hand conchiolin. Dissolved calcium sulphate, chloride, &c., are precipitated as calcium carbonate, which is disposed in various ways in the conchiolin. The fresh conchiolin suffers oxidation, which is accompanied by brown coloration, and carbon dioxide is probably given off. Neither the appearance of the brown pigment, nor the making of the shell, is in the strict sense a vital process. Steinmann alludes to the corroboration of his work by Murray and Irvine.*

Formation of Pearls.†—M. Leon Diguet has a note on the difference in origin between the true pearls and the so-called nacreous pearls. The latter arise from deposits of nacre formed by the secretion of the mantle glands round foreign particles, and are in origin analogous to the deposits which increase the shell. The true pearl, on the other hand, is the result of a special physiological process having for its object the elimination from the body of a parasite or some special cause of irritation. It originates as an ampulla, filled with an organic fluid, which gradually undergoes condensation; when the condensation is completed, the mass, which now consists of a substance analogous to conchiolin, becomes stratified, leaving interstices between the strata, which are filled by a calcareous deposit. After calcification the wall of the ampulla is so thin that the pearl can be readily freed by its rupture.

α. Cephalopoda.

Tentacles of Nautilus pompilius.‡—Mr. L. E. Griffin publishes some notes on these structures based on the study of a large series of specimens. He finds that the digital tentacles have their surface marked by a series of annular grooves, and that the central nerve of the tentacle bears swellings corresponding to the segments between the annulations. The inner surface of the segments is flattened, and the arrangement of the muscles enables them to act as suckers. Though the adhesive power of each particular segment is slight, their number gives considerable adhesive power to the tentacles as a whole. The author believes that these simple suckers are the homologues of the suckers of the Dibranchiates, and that the arms of the latter are homologous with the tentacles of *Nautilus*. As the suckers became more specialised, the tentacles became greatly reduced in number. The ocular tentacles of *Nautilus* are to be regarded as modified and displaced digital tentacles. The organ known as Van der Hoeven's organ, which is present in the male only, is the homologue of the inferior labial lobe of the female, but its function is doubtful. The hectocotylus of the male consists of a group of four modified tentacles usually situated on the left side. It may however occur on the right side, or rarely on both sides. It seems possible that the organ was originally always paired.

* Proc. Roy. Soc. Edin., 1889.
† Comptes Rendus, cxxviii. (1899) pp. 1589–91.
‡ Johns Hopkins Univ. Circ., 1898, pp. 11–12. See also Ann. and Mag. Nat. Hist., iii. (1899) pp. 170–6.

γ. Gastropoda.

Phylogeny of Gastropods.*—Dr. Guiart seeks to modify somewhat the phylogenetic arrangement of the Gastropoda and of the Opisthobranchs in particular. His scheme, based on the disposition of the nervous system, is the following:—

PODONEURA | NOTONEURA

Gymnosomata — *Notarchus* — Aplysiidæ | Nudibranchs

Acera

Thecosomata — *Lobiger* — Bulleidæ | Pleurobranchs

Acteon | *Tylodina*

Acteonidæ

Prosobranch Monotocardia (Aponotoneura)

Prosobranch Diotocardia (Epipodoneura)

Arthropoda.

α. Insecta.

Protective Adaptations in Insects.†—Prof. S. D. Judd has examined the stomach contents of fifteen thousand birds in the United States, and writes a very interesting article on the value of the protective adaptations of insects with special reference to colour. From the nature of the paper a detailed abstract is not easy, but the following are some of the observations and conclusions contained in it. Insects which resemble the substratum on which they rest are not necessarily protected by this resemblance; thus protectively coloured grasshoppers are habitually eaten by over three hundred species of birds in the States, and in many cases the birds eat stationary and not moving specimens. Similarly the admirably "protected" weevils are eaten by numerous birds, and so with other protected forms. Hairs and stings, on the other hand, seem very efficient in protecting their possessors from attack. Insects furnished with nauseating fluids are not invariably avoided, whether their colours be bright or not; but the families Coccinellidæ and Chrysomelidæ, which include showy ill-scented insects, are usually avoided. As to warning coloration and mimicry, there is

* Bull. Soc. Zool. France, xxiv. (1899) pp. 56–62 (6 figs.).
† Amer. Nat., xxxiii. (1899) pp. 461–84.

no evidence that any birds prey habitually upon butterflies, whatever the colours of the butterflies. With regard to the kingbird a very curious fact was noticed. It eats *Eristalis* and many other "mimicking" forms and also the *drones* of the bee. A similar power of distinguishing between drones and workers on the wing has been observed in the common fowl, indicating a keenness of observation which must have some bearing on the theory of mimicry. The author does not draw any very definite conclusions, but believes that colour is at most only one of the factors which determine whether or not an insect will be attacked by birds.

Morphology of the Abdomen.*—Dr. R. Heymons gives a critical review of anatomical and embryological studies bearing on the structure of the abdomen in insects. Among the conclusions the following may be noted. As to the component segments, twelve is probably the primitive number; eleven and a telson are still demonstrable in some forms. A typical segment consists of a dorsal tergite arising from two lateral halves, a ventral sternite primitively tripartite, and connecting pleural membranes with the stigmata. The telson seems to be typically composed of three plates or *laminæ anales*.

As to appendages, the cerci which belong to the eleventh segment are appendicular and are closely comparable to antennæ; the styles are vestigial structures originally appendicular, but there are various abdominal outgrowths which have not this value; the gonapophyses, about which there has been so much debate, are here regarded as epidermic processes peculiar to the class Insecta.

Parasitic Fly of Chinese Silkworms.†—Prof. C. Sasaki notes that in Italy silkworms are infested by larvæ of *Senometopia gumicata* Meig and *Doria meditabunta*, in Bengal by *Œstrus bombycis*, in Japan by *Ugimyia sericariæ*. To these he adds *Tachina rustica* L. (syn. *Musca nigricans* Fabr., *Musca larvarium* De Geer), parasitic on Chinese silkworms. He describes the maggot and both sexes of the fly, and notes that the fly deposits its eggs on the body of the silkworms.

Pygidial Glands of Staphylinidæ and Cicindelidæ.‡ — M. Fr. Dierckx has a brief paper on this subject, in which he entirely rejects the descriptions and explanations of M. Bordas.§ In the species of *Staphylinus* the offensive glands consist of two dark sacs communicating with two white cuticular sacs which open to the exterior. When the abdomen is compressed, the dark sacs slip into the transparent ones, and the latter are invaginated to the exterior (cf. the movements of the tentacles in the snail), at the same time the contents of the dark sacs are discharged. These dark sacs are lined by the secretory epithelium. In the species of *Cicindela* the organ has a structure similar to that found in the Carabidæ; that is, it consists of a simple glandular follicle, a collecting tube, and an ovoid cuticular sac forming the reservoir.

Morphology of Stinging Apparatus in Hymenoptera.‖—Dr. Enoch Zander has studied a series of these insects with a view to determining

* Zool. Centralbl., vi. (1899) pp. 537–56.
† Annot. Zool. Japon., iii. (1899) pp. 25–8 (4 figs.).
‡ Zool. Anzeig., xxii. (1899) pp. 311–5 (12 figs.).
§ Ann. Fac. Sci. Marseille, ix. (1899) p. 230.
‖ Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 289–329 (2 pls.).

the question of the origin and relations of the different components of the sting. He finds that the twelfth body segment develops in the same way as do the other segments; but while in these the parts become tergum, sternum, &c., in the metamorphosed twelfth segment they become parts of the stinging apparatus. Thus the epipygium represents the tergum, the oblong plates, with their connecting membrane, the sternum. The Terebrantia retain the primitive condition in that these parts fuse into a complete ring similar to the other body rings, while in the Aculeata the separate parts are withdrawn into the abdomen. Further careful examination of the abdominal segments shows that their anterior (presegmental) and posterior (postsegmental) surfaces display secondary thickenings and outgrowths. Homologous structures occur in relation to the eleventh and twelfth segments and form parts of the sting. The homologies of these parts are considered in detail. As to the morphology of the gonapophyses in the narrow sense (darts, sheath, and groove), the author does not believe that these can be homologised with abdominal appendages, but regards them as new formations having no relation to appendages. Their rudiments are post-embryonic, appearing much later in development than the rudiments of the true abdominal appendages, which appear and disappear in the embryonic stage.

Regeneration in the Mantidæ.*—M. Edmond Bordage finds that in this family, as in the other pentamerous Orthoptera, regenerated limbs have four joints in the tarsus in place of the normal five. As, including the present observations, tetrameric regeneration has been observed in eighteen pentamerous Orthoptera distributed in the three families, the author concludes that it occurs in the whole group. It also seems to follow from the author's observations that as a rule the tetramerous regeneration of the tarsus in Orthoptera pentamera after self-mutilation has its seat in the trochantero-femoral groove.

Wings of Insects.†—Messrs. J. H. Comstock and J. G. Needham conclude their discussion of the specialisation of wings by addition with an account of the tracheation of the wings of Orthoptera. In this and preceding instalments they furnish data for determining the homologies of the veins in each of the orders of winged insects except the Euplexoptera, Mecaptera, Isoptera, and Physopoda. From this phase of the subject they propose to pass to a study of the beginning of wings.

Histology of Digestive Tube in the Larva of Chironomus.‡—P. Vignon strongly opposes the vesicular theory of the secretion of glandular cells. He believes that the vesicles described by many authors are due to injury to the cells produced during fixation; they are never visible in living intact animals. He finds further that the peritrophic membrane has no relation to the coats of the chylific stomach, but arises from the mid-gut above the proventriculus. In some specimens cilia are distinctly demonstrable in the three regions of the chylific stomach, and also in the terminal part of the intestine where the chitin is very thin.

* Comptes Rendus, cxxviii. (1899) pp. 1593-6; Trans. in Ann. and Mag. Nat. Hist., iv. (1899) pp. 115-8.
† Amer. Nat., xxxiii. (1899) pp. 573-82 (8 figs.). Cf. this Journal, *ante*, p. 155.
‡ Comptes Rendus, cxxviii. (1899) pp. 1596-8.

Thrips of the Olive.*—Dr. G. del Guercio describes the life-history and habits of *Phlœothrips oleæ* (Costa) Targioni, and discusses the most effective means of getting rid of the pest.

Autotomy in the Phasmidæ.†—M. Edmond Bordage, in studying specimens of *Rhaphiderus scabrosus* kept in captivity, noticed that during the ecdyses the insects had great difficulty in freeing their long legs from the old coat; some 31 per cent. died or were mutilated in the process. He believes that the characteristic fusion between femur and trochanter was produced in ancestral Phasmids by the mechanical strains involved in the process of struggling. The fusion results in the formation of a *locus minoris resistentiæ*, where separation of the limb can take place without fear of hemorrhage. He believes that a similar explanation is applicable to other Arthropods, showing fusion of limb segments.

Male Reproductive Organs of Beetles.—Dr. L. Bordas‡ pursues his researches on this subject, describing the male reproductive organs of Cleridæ. As regards the disposition of seminiferous canaliculi, the testis in this family is intermediate between that of Melolonthidæ and Geotrupidæ and that of Elateridæ and Telephoridæ. The more or less marked reddish tinge of the whole apparatus is remarkable, and indeed unique in beetles.

He also describes, in another paper,§ the macroscopic and minute structure of the male reproductive organs of *Timarcha*, *Chrysomela*, *Oreina*, *Agelastica*, and other Chrysomelidæ. In fourteen species the essential part consists of a series of spermatic ampullæ or capsules, very variable in form, disposition, number, and dimensions. The seminal vesicles tend to be reduced. The accessory glands are sometimes rudimentary and ovoid (*Timarcha*), sometimes tubular, cylindrical, or flattened (*Chrysomela*, *Oreina*), and so forth. Five principal parts are described:—testes, *vasa deferentia*, accessory glands, seminal vesicles, and ejaculatory ducts, to which a copulatory apparatus may be added.

β. Myriopoda.

Researches on the Chilopoda.‖—O. Duboscq publishes under this title a series of observations on the epidermis, mesenchyme, and connective tissue of Chilopoda. He finds that the chitin, except at the articulations, consists of (1) an external unstainable layer; (2) a median layer which takes up both basic and acid stains; (3) a very thick internal layer which is stratified and stains faintly with acid dyes. The articular chitin differs in the absence of the outer layer, and the slight development of (3). As to the sensory cells of the epidermis and the significance of the setæ, the author finds himself unable to decide whether the sensory cells are or are not identical with the cells giving rise to the setæ, but he inclines to the belief that they are. He finds that the nerves of the sensory cells are formed by elongated processes of the cells themselves. Apart from the eyes, the setæ in the Chilopoda constitute the only

* Atti Accad. Georgofili, xxii. (1899) 29 pp. (6 figs.).
† C.R. Hebd. Séances Soc. Biol., v. (1898) pp. 839–42; Trans. in Ann. and Mag. Nat. Hist., iii. (1899) pp. 158–62.
‡ Ann. Soc. Entomol. France, lxvii. (1898) pp. 622–30 (1 pl.).
§ Journ. Anat. Physiol., xxxv. (1899) pp. 385–407 (2 pls.).
‖ Arch. Zool. Expér., vi. (1898) pp. 481–650 (7 pls. and 21 figs.).

sense-organs, and the animals are sensitive according to the number of setæ present. The epidermis contains numerous scattered unicellular glands. The cells may reach a great size; and when a number of glands are aggregated together, very conspicuous structures may be produced. Such are the ventral glands of the Geophilidæ and the poison-glands of Chilopoda in general. The ventral glands produce a clear limpid fluid which coagulates in air and is slightly phosphorescent in some Geophilidæ. The poison-gland, like the ventral glands, consists of a number of unicellular glands compacted together; but an invagination of the integument has provided the cells with a common excretory canal, and made the gland appear internal. The poison is distinctly acid in reaction; it acts only upon Arthropods and Vertebrates. The author also considers in detail the metameric glands of the anterior region of the body. He wholly rejects the idea of their homology with tracheæ, but considers them homologous with the anterior glands (salivary glands, &c.) of insects. In connection with the mesenchyme the author has studied the anatomy of the circulatory system, and the histology of the blood-vessels and of the blood. In *Scolopendra* the very simple distribution of the vessels recalls the conditions seen in Annelids. Except in the anterior region, the latero-dorsal and latero-ventral vessels or their branches bear small rounded bodies, the corpuscles of Kowalevsky. These are confined to the family Scolopendridæ. The author thinks that they are to be regarded as persistent portions of embryonic mesenchyme, analogous to the spleen of Vertebrates. He does not agree with Kowalevsky, who assigns to them a very important phagocytic function. The blood contains the following formed elements: (1) small cells with large nuclei which probably arise from the corpuscles of Kowalevsky; (2) uninucleated cells of large size functioning as active phagocytes, and arising from the preceding; (3) degenerating cells with small nuclei. In the connective tissue the most interesting cells are those which have the power of taking up carminate of ammonia injected into the blood. These are sometimes placed round the salivary glands, sometimes near the Malpighian tubules, sometimes round vessels or sinuses. These diverse situations recall the position of the similar cells in different Arthropods (scorpion, insects, &c.) Round the intestine the author finds a remarkable and previously undescribed perivisceral sinus which is not cœlomic, but whose relations to the embryonic cœlom are worthy of investigation.

Studies on Myriopods.*—Dr. C. Verhoeff continues his account of palæarctic Myriopods, the present communication dealing with the comparative morphology, the phylogeny, and the taxonomy of the Chordeumidæ.

γ. Protracheata.

American Species of Peripatus.†—E. L. Bouvier draws attention to certain minor peculiarities noticed in the American species of *Peripatus*, and their systematic value. He finds that the New World forms can be arranged in regional groups, each locality being characterised by its peculiar species or varieties. He discusses the means of identifying the species and their relations to the other known species.

* Arch. Naturgesch., lxv. (1899) pp. 95–154 (5 pls. and 4 figs.).
† Comptes Rendus, cxxviii. (1899) pp. 1344–6.

ε. Crustacea.

Respiratory Organs of Oniscidæ.* — Mr. J. Stoller has subjected these organs to a detailed histological examination in several genera, with special reference to the *corpora alba* found on the outer gills in *Porcellio* and *Armadillidium*. In these genera some or all of the outer gills bear white structures which careful examination shows to be tree-like organs having a single opening to the exterior, and formed by an inturning of chitin. These contain air, and are in some respects comparable to the tracheæ of insects. The author is of opinion that their function is to enable the Isopods to breathe dry air, while the inner gills, which are without trees, can serve as respiratory organs only when the air is moist. As the terrestrial Isopods have arisen from aquatic ancestors, those forms in which all five pairs of outer gills bear trees must be considered more specialised than those in which there are two pairs of these organs only. In *Lygidium hypnorum*, which lives only in very moist situations, no trees or similar structures are present on the outer gills. In *Oniscus murarius* the trees are again absent, but the outer gills contain an elaborate series of chambers whose function the author believes to be similar to that of the trees, that is, they enable the animal to breathe in ordinary atmospheric air.

Winter Egg of Leydigia acanthocercoides Fisher.† — Mr. D. J. Scourfield describes for the first time the winter egg of this rare water-flea. The egg is enclosed in a proto-ephippium of complex structure, which is formed from a relatively small portion of the shell of the mother, and is provided with large hooks whose function is probably to ensure the distribution of the egg. Between the egg and the proto-ephippium there is a mass of spongy tissue. The egg-case, as a whole, differs from the true ephippium of Daphnids in the absence of surface sculpture, but in its general structure forms a link between the egg-cases of this family and those of other Lynceids.

Annulata.

Morren's Glands in the Lumbricidæ.‡—M. Edouard de Ribaucourt finds that in *Lumbricus* there are four pairs of Morren's glands, and not three as hitherto supposed. Of these the minute newly discovered posterior one is the oldest, the anterior and the two median ones are secondary differentiations. In *Allolobophora hermanni* Michaelsen the four pairs of glands are entirely absent. Between this condition and that seen in *Lumbricus herculeus* it is possible to trace a complete series of stages, illustrating the gradual development of the condition where four pairs of glands are present.

Observations on Oligochætes.§ — Dr. W. Michaelsen has investigated some fragments of a worm in the Hamburg Museum labelled *Georyctes menkei* Schlotthauber. He finds that its true name should be *Phreoryctes gordioides* Hartmann, a species with a very extensive synonymy. The author finds that the first segment is rudimentary, a

* Bibliotheca Zoologica, xxv. (1899) pp. 1–31 (2 pls.).
† Journ. Quekett Micr. Club, vii. (1899) pp. 171–9.
‡ Comptes Rendus, cxxviii. (1899) pp. 1528–30.
§ Zool. Jahrb., xii. (1899) pp. 105–44 (2 figs.).

fact not hitherto observed. His specimens had better developed sexual organs than those previously described, but did not seem to be fully mature. There were two very large pairs of testes, two pairs of seminal funnels, and two open sacs representing the seminal vesicles of higher forms. The female organs consisted of two pairs of large ovaries overlapped by the funnels of the oviducts. In addition there were apparently two unpaired egg-sacs. The only one which was distinct consisted, like the seminal vesicles, of a pocket on one of the dissepiments. There were also three pairs of spermathecæ.

The paper also includes an account of some Oligochætes from Switzerland, with a description of a new species of *Nais*. This form, described as *Nais bretscheri*, is remarkable for the arrangement of its bristles. These are of very different calibre in different regions of the body, and the number in the ventral bundles is inversely proportional to the thickness of the individual bristles. The paper also includes descriptions of Oligochætes collected from various localities, of which a number are new species.

Oligochætes from the Islands of the Pacific.*—Dr. W. Michaelsen describes a collection of earthworms made by Dr. Schauinsland during a Pacific voyage. He believes that the *Pontodrili* are the only purely indigenous forms. Their habitat is among the débris of the shore, and this, together with their resistance to the action of salt water, makes it possible for them to be distributed by sea in a fashion impossible to the purely terricolous forms. As to their relations, the prostate arises from the modified openings of the *vas deferens* as it does in the Perichætinæ, so that they must be placed in this sub-family near *Megascolides*. The paper includes a discussion of the family Megascolecidæ.

Ciliated Bodies of Phymosoma granulatum.†—MM. J. Kunstler and A. Gruvel describe these peculiar bodies which move in the perivisceral fluid. In the phase which may be called adult they are like permanent gastrulæ with large open posterior blastopore. Their cavity, however, is not digestive, but is lined by germinal epithelium constantly budding off cells. The authors find in this some support for the view that the primitive gastrula was a "genito-gastrula," the original rôle of the endoderm being reproductive.

Regeneration in Annelids.‡—A. Michel has made an elaborate study of regeneration in Chætopod worms, extending his experiments over a wide series. Among the outstanding results the following may be noted. In the cicatrisation the gut is only closed by a mechanical obstruction; the leucocytes play little part in healing or regenerating; mitoses are relatively rare. All the tissues and organs of the regenerating bud spring from the proliferating ectoderm or epidermis which the author speaks of as indifferent. He thus seeks to lessen the difficulty suggested by some of his results, e. g. that intestinal epithelium, muscles, &c. may arise from the ectoderm.

Embryology of Protula Meilhaci.§—M. Albert Soulier has been successful in rearing larvæ of this worm at the Marine Station of Cette.

* Zool. Jahrb., xii. (1899) pp. 210–46.
† Comptes Rendus, cxxviii. (1899) pp. 519–21.
‡ Bull. Sci. France et Belg., xxxi. (1898). See Zool. Centralbl., vi. (1899) pp. 564–7.
§ Comptes Rendus, cxxviii. (1899) pp. 1591–3.

The egg contains much yolk, and segmentation is markedly unequal. Gastrulation is by epibole, a vitelline mass which constitutes the future endoderm and mesoderm being enclosed by the overgrowth of the ectoderm. The two primitive mesoderm cells appear late, after the closure of the blastopore. Both mouth and anus are derived from the blastopore. The free-swimming stage is very short, and by the fifteenth day the tube appears as a simple ring secreted by the collar. As contrasted with that of *Serpula*, the embryonic life is condensed.

Eyes of Polychætes.* — Dr. Richard Hesse has investigated the structure of the so-called eyes in a great number of Polychætes, including both predatory and sedentary forms. In the littoral predatory forms, the conditions found in the species of *Nereis* are typical. The eyes are little vesicles, with cellular walls formed by an invagination of the epidermis. In some cases (as in *Nereis*) the vesicles are completely closed, their outer surface being covered by the cuticle. In other cases (*Phyllodoce*, *Eunice*, &c.) the vesicle retains an opening to the exterior, and through this the cuticle is connected with the central refracting mass. The wall of the optic pit is formed first by a double layer of unpigmented cells (outer and inner cornea), then by a pigmented layer (retina). The pigmented layer is composed of two kinds of cell:— (1) sensory cells, which are connected proximally to nerve-fibrils, and distally are continued into rod-like structures; (2) secretory cells, which bear fibrils continuous with the refracting substance. The secretory cells secrete this refracting substance, which is analogous to the cuticle formed by the other epidermal cells. In *Phyllodoce* the refracting substance takes on more of the characters of a true lens. The segmental eyes of *Lysidice viridis* (palolo) have a totally different structure. They consist of a bundle of greatly elongated cylindrical cells imbedded in a mass of pigment, and proximally continuous with fibrils which pass into the ventral nerve-cord. The author believes that they are organs for the reception of light, though there is no reason to believe that they can form images.

The author has also made out some fresh points in connection with the eye of *Alciope*. In the retina he finds sensory cells and secretory cells, as in *Nereis*. The sensory cells are continued distally into rods, and the centre of the rod contains a slender fibril, apparently of nervous nature, which bears a little knob at its distal extremity. Proximally the fibril seems to be continued into the sensory cells itself. The author believes that the remarkable knob is the end-organ of the sensory cell. Further, he believes on morphological grounds that the eye of *Alciope* has some power of accommodation.

The sedentary Polychætes show, in regard to their eyes, much greater variety of form than the predatory forms. Their eyes are of two main types, (1) cup-shaped, (2) epithelial. The epithelial eyes are merely patches of specialised cells continuous with the epidermis. They may consist of single cells with a mantle of pigment, or of a number of such cells. There are two main types; in the one, the sensory cells are continued into receptive rods; in the other, the sensory cells secrete a lens-like substance which is continuous with the cuticle. In the cup-

* Zeitschr. f. wiss. Zool., lxv. (1899) pp. 446–516 (5 pls.).

shaped eyes the sensory cells project at one end into a cup-shaped mass of pigment, and at the other are continuous with a nerve-fibril. Such eyes are very common, and occur also in Annelid larvæ. As in many cases simple eyes of these types can only be recognised by the associated pigment, it is possible that forms like *Arenicola*, which are sensitive to light but without eyes, may have sensory cells not accompanied by pigment.

Nematohelminthes.

Hystrichis and Tropidocerca.*—Dr. O. von Linstow discusses these two genera, whose representatives live in the mucous membrane of the proventriculus of birds, and almost exclusively in littoral birds. The first genus belongs to the Pleuromyaria without lateral ridges, and with muscles in the lateral lines, and is also included in Molin's Acrophalli. The second genus, which is one of the Secernentes, is remarkable for the extraordinary sexual dimorphism, which is almost unequalled among Helminths.

Giant-Ova of Ascaris.†—Dr. O. L. Zur Strassen finds that in *Ascaris megalocephala* the so-called giant-ova always arise from the fusion of two separate ova; thus differing from L. Sala, who held that they might also arise from the incomplete division of a primordial ovum. The coalescence may occur at very different stages, and details of the different cases are described. If multiple fertilisation occurs, the result is abnormal development; if a single spermatozoon enters, the result is a normal embryo of large size. The cells of the germinal area in such cases have, like the ova, six chromosomes instead of the typical four. Zur Strassen concludes that neither the quantity of protoplasm nor the number of chromosomes is of important influence on the development, but he lays great emphasis on the number of centrosomes.

Peculiar Cells in the Cavity of Nematodes.‡—Herr W. Schimkewitsch describes peculiar elements which he found in the general cavity of a free-living Nematode (probably a species of *Oncholaimus*). They occur throughout the whole body, approximately arranged in four rows, and sometimes connected with the gut. They are irregular in form, and are rich in granules which stain vividly with methylen-blue. Possibly they are comparable to the elements of the peritoneal epithelium peculiar to Gordiidæ, but here remaining in a more primitive unconnected state, instead of forming a layer. It is probable that they have some blood-purifying function.

Platyhelminthes.

Cestodes from Marsupials.§—Herr F. Zschokke has investigated the tape-worms taken from a collection of mammals from the Australian region. The paper is largely systematic, but contains some general statements as to distribution. As far as is at present known, the Cestodes infesting Marsupials and Monotremes all belong to the sub-family Anoplocephalinæ, whose members typically infest herbivorous Placentals. There is a certain parallelism between the Cestodes of the

* Arch. Naturges., lxv. (1899) pp. 155–64 (2 pls.).
† Arch. Entwickmech., vii. (1899) pp. 642–76 (2 pls.). See Zool. Centralbl., vi. (1899) pp. 400–2.
‡ Biol. Centralbl, xix. (1899) pp. 407–10 (2 figs.).
§ Zeitschr. f. wiss. Zool., lxv. (1899) pp. 392–445 (2 pls.).

Placentals and those of non-placentals. Thus the genus *Moniezia* occurs in purely herbivorous animals, as in Ruminants and the kangaroo; the genus *Bertia* is found in mammals living on fruits, leaves, and insects, as in the Eutherian *Galeopithecus* and the Marsupials of similar diet (*Phascolarctus, Phalanger*). On the other hand, *Echidna* and *Perameles* are infested by the members of a new genus (*Linstowia*), not yet known in Placentals.

Scyphocephalus bisulcatus g. et sp. n.* — Dr. Emanuel Riggenbach describes under this name a new reptilian Cestode, which is peculiar among those Cestodes with bothria in having three suctorial pits. In its structure it resembles the members of the family Bothriocephalidæ, except for the presence of three instead of two pits. The third has a circular terminal orifice, and constitutes a very efficient fixing apparatus. It is sunk deep in the scolex, and is slightly conical within. The lateral pits are as long as the scolex, and form narrow grooves; their musculature is reduced. The form was found in *Varanus salvator*.

Macraspis elegans Olsson.†—Herr L. A. Jägerskiöld gives a preliminary account of this remarkable Trematode parasite of *Chimæra* which Olsson discovered and described in 1869. But Olsson's description, good so far as it went, did not go very far, and Jägerskiöld has therefore had a free hand in his account of the internal structure of this interesting Aspidobothrid.

Development of Distomum leptostomum Olsson.‡—Dr. Karl Hofmann has investigated a *Cercariæum* which he found in abundance in common species of *Helix*, *Arion*, and *Succinea*. He removed the specimens from the kidney of the snails, and was able to keep them alive for some days in a solution made of 90 per cent. normal salt solution, 10 per cent filtered white of egg, and a trace of camphor. The animals were fixed in 5 per cent. corrosive sublimate. Various stains were used, especially a modification of Gieson's method—staining with tetrabromfluorescein, washing with water, and restaining with calcium triphenylrosanilintrisulphate in concentrated aqueous picric acid for ten minutes, then successive treatment with water, alcohol, turpentine, balsam.

An examination at once showed that the parasites were not all alike, some being furnished with spines which were absent in the others. The former are specimens of *Cercariæum helicis*; for the latter a new species—*C. spinulosum*—must be erected. In their internal structure the two agreed very nearly. The structure of the first species is described in detail. The young cercariæ creep out of greatly branched tubes which ramify through the liver and represent the sporocyst. Within the sporocyst lie the young cercariæ, which are furnished with an appendage homologous with the tail of the free-swimming forms. This appendage is usually but not quite invariably lost when the larvæ leave the sporocyst; but occasionally cercariæ found in the intestine of the second host—the hedgehog—still possess it. There is no doubt that the *D. caudatum* of Loos was founded on such abnormal forms. To obtain sexually mature specimens, young hedgehogs were fed with

* Zool. Jahrb. (Abt. Syst.), xii. (1899) pp. 145–53 (1 pl.).
† Ofversigt k. Vetensk. Akad Förhandl., lvi. (1899) pp. 197–214 (9 figs.)
‡ Zool. Jahrb. (Abt. Syst.), xii. (1899) pp. 174–204 (2 pls.).

infested snails. Eggs of the parasite were found in the fæces of the hedgehog seventeen days after feeding, and after about a month both hedgehogs died of intestinal inflammation induced by the swarms of parasites in the intestine. The sexually mature *Distomum* agrees in most respects with the cercaria, save for an elongation of the body and the modifications produced by the presence of the ripe gonads. The spinose cercariæ produce a spinose adult forming the species *Distomum spinulosum.* In order to complete the cycle of observations, snails were fed on leaves sprinkled with *Distomum* eggs, and the eggs themselves were cultivated in extract of snail's stomach. The feeding experiments did not yield absolutely satisfactory results, but the cultures showed that the eggs hatch at once in the digestive fluid of the snail without previous immersion in water. The free miracidium finds its way to the interstitial connective tissue and becomes a vesicular sporocyst, which later grows out into a much branched tube containing swarms of cercariæ.

Regeneration in Planaria.* — Prof. T. H. Morgan has made numerous experiments with *Planaria maculata.* Some of the results may be briefly noted. Transversely cut portions may grow a new "head" and "tail." The pharynx may be re-formed in different ways according to the position of the cut. The transversely cut portions decrease in breadth and increase in length. If the foremost portion in front of the eyes be cut off, it does not regenerate an entire worm, as is the case if the cut pass just behind the eyes. As even smaller portions than that in front of the eyes may re-grow a whole, the absence of regenerative capacity in the most anterior portion cannot be accounted for by the small size, but perhaps by the greater specialisation. In most cases the regeneration shows a distinct polarity, but there is great diversity of results, thus a head may be formed at each end. The author compares the material of this marvellously plastic body to that of a segmenting ovum.

Gyrodactylus in Salt Water.† — Prof. L. Kathariner records the occurrence of *G. medius* in *Motella communis* from Heligoland, and in species of *Cyprinodon* from warm mineral water in the Sahara. A few cases of its occurrence in marine fishes have been previously noted. As its usual habitat is on fresh-water fishes, its power of acclimatisation must be great.

Incertæ Sedis.

Rhabdite-"cells" in Cephalodiscus.‡ — Mr. F. J. Cole, in the course of an investigation of some fragments of *Cephalodiscus*, has discovered some remarkable structures in the branchial plumes. As is well known, these terminate in bulbous enlargements regarded by Masterman as eyes. When stained with Dr. Mann's methyl-blue-eosin, it is found that these bulbs are covered by "cells" containing rhabdites in all respects similar to those of Turbellarians or Nemerteans. The wall of the bulb consists of (1) a series of large nucleated basal cells, and (2) a series of non-nucleated bodies placed in vacuoles and termed

* Arch. Entwickmech., vii. (1898) pp. 364–97 (41 figs.). See Zool. Centralbl., vi. (1899) pp. 560–2.
† Zool. Anzeig., xxii. (1899) pp. 328–9.
‡ Journ. Linn. Soc. (Zool.), xxvii. (1899) pp. 256–68 (1 pl.).

rhabdite-"cells." The latter secrete a homogeneous sphere which becomes split up into numerous rods or rhabdites, which are discharged to the exterior. The two structures together must be regarded as equivalent to the rhabdite-cells of the Turbellaria; for the non-nucleated bodies are probably dissociated parts of the basal cells. The bulbous enlargements of the plumes are therefore to be regarded not as sense-organs but as rhabdite-batteries.

Sexual Phases of Myzostoma.*—Prof. W. M. Wheeler criticises Beard's conclusion that *Myzostoma glabrum* is dimorphic, and that the species is represented by hermaphrodite individuals and by dwarf "complemental males" attached to the dorsal surface of the large hermaphrodite individuals which adhere to the peristome of *Antedon rosacea*.

Wheeler's position, which Beard has criticised, but to which the author firmly adheres, is "that *M. glabrum* is monomorphic, each individual of the species being from the first hermaphrodite, i.e. possessing both ovaries and testes, and being, like other members of the genus (notably *M. cirriferum* and *M. alatum*), protandric, then hermaphrodite, and ultimately more or less hysterogynic. In other words, the functional male phase (Beard's 'complemental male') passes into the functional hermaphrodite phase as soon as the first ova mature, and the functional female phase begins with the atrophy or disappearance of the testes. The cysticolous and entoparasitic species of the genus tend towards a condition in which the functional male and female phases overlap but little, thus exhibiting only a brief functional hermaphrodite phase (*M. eremita*); or these phases no longer overlap, and thus present two well-marked periods of sexual maturity, one male and the other female (*M. pulvinar*)."

North American Fresh-water Bryozoa.†—Dr. C. B. Davenport begins a series of proposed systematic synopses of North American Invertebrates with a key for the determination of the Bryozoa. In undertaking this useful piece of work, the *American Naturalist* promises to determine and return any specimens that cannot be placed in the keys, and solicits correction and criticism for future revision.

Development of Orthonectids.‡—MM. M. Caullery and F. Mesnil discuss in particular the "plasmodial sacs" of *Stœcharthrum giardi* Caull. et Mesn., which they regard as expressing a phase of asexual multiplication after the parasite enters its annelid (*Scoloplos*) host. They agree in a general way with Giard in comparing the plasmodial sacs to sporocysts in Trematodes. More exactly, however, the plasmodial sacs are comparable to the axial cell in Dicyemidæ.

Echinoderma.

Development and Anatomy of Synapta vivipara.§—Mr. H. L. Clark has made a series of detailed observations on this curious form, which

* Zool. Anzeig., xxii. (1899) pp. 281–8.
† Amer. Nat., xxxiii. (1899) pp. 593–6 (3 figs.).
‡ Comptes Rendus, cxxviii. (1899) pp. 516–9.
§ Mem. Biol. Lab. Johns Hopkins Univ., iv. (1898) pp. 53–88 (5 pls.).

is the *Synaptula vivipara* of Œrsted. It occurs in large numbers in the so-called "lakes" at Port Royal, in Jamaica, apparently always inhabiting the branches of *Acanthophora thierii*, one of the Florideæ. Breeding probably goes on all the year round, and birth takes place by the rupture of the body-wall close to the anus. The ova seem to be shed into the body-cavity by the rupture of the epithelium of the gonad. The genital duct has no obvious opening to the exterior, but as it is usually filled with spermatozoa, there are probably minute openings through which these escape. The author believes that cross-fertilisation occurs at least usually, the sperms reaching the body-cavity, and thence the eggs through tubes which connect the rectum and the body-cavity. The animals being social, the water must be filled with sperms which may enter through the anus. Development takes place within the body-cavity, and the elliptical larva is without ciliated bands, calcareous plates, or larval nervous system. The development of the pentactula occurs much as in other species, but there is no cessation of growth at this period, and the pentactula is gradually transformed into the adult. An important difference from *S. digitata* is the total absence of radial canals even in the embryo. As to the structure of the adult, besides the points already mentioned, we note as peculiarities the presence of "eyes" at the base of the tentacles, and the fact that the stone-canal opens both to the exterior and into the body-cavity. The author considers that his observations support Ludwig's view that the Synaptidæ are degenerate pedate Holothurians.

Experiments with Sea-Urchin Eggs.* — Prof. J. Loeb finds that weak alkaline solutions quicken the development of the eggs of *Arbacia*. The quantity required is very minute, $1\frac{1}{2}$–2 ccm. of a $0 \cdot 1$ normal sodium hydrate solution to 100 ccm. of sea-water (about ·0006 per cent.) Acids have an inhibiting effect. It is suggested that alkalies promote the oxidation processes and thus the synthetic processes in the cells, and that inequalities in growth may be partly dependent on differences in the alkalinity or acidity of different portions of the germinal area. Corroboratory experiments were made on the eggs of the Teleost fish *Fundulus*; the addition of a little hydrochloric acid retarded the development; the addition of an alkali had hardly any effect.

Notes on Arctic Echinoderms.†—Herr L. Döderlein describes interradial brood-chambers above the openings of the ovaries in *Pteraster hexactis* Verrill, and makes various other notes, e.g. on the variability of the calcareous plates of the dorsal skeleton of *Solaster* (*Crossaster*) *papposus*, and on the specific stability of *S. syrtensis*, &c.

Reproductive Organs of Echinoderms.‡—Prof. A. Russo maintains (1) that in all the groups of Echinoderms the reproductive cells differentiate from peritoneal elements which line the general cavity; (2) that the reproductive elements, as in many groups of higher animals, originally form cellular cords which by special adaptations afterwards acquire their characteristic form; (3) that the living forms may be divided into two groups as regards their gonads, the one including

* Arch. Entwickmech., vii. (1898) pp. 631–41 (1 pl.). See Zool. Centralbl., vi. (1899) p. 380.
† Zool. Anzeig., xxii. (1899) pp. 337–9. ‡ Tom. cit., pp. 288–92 (3 figs.).

Holothuroids and Crinoids (Monorchonia of Haeckel), and the other including Ophiuroids, Asteroids, and Echinoids (Pentorchonia of Haeckel).

Cœlentera.

Structure of Two Zoantharia.*—Prof. A. R. v. Heider describes the anatomy of two forms from the collection of the 'Vettor Pisani.' The one belongs to the genus *Palythoa*, and is apparently a new species —*P. brasiliensis.* It is a colonial form with the mesoglœa and cœnochyme filled with incrusting sand-particles which greatly interfere with the process of section-cutting. The polyps are separated from one another only by a thin mesoglœa, invested on both sides with endoderm, and continuous with the cœnochyme which fills up the angles between the contiguous polyps, and also with the basal cœnochyme. Both cœnochyme and mesoglœa have the same structure, being traversed by canals and impregnated with foreign particles. In the upper part of the polyp lies the sphincter, which is mesodermal and only slightly developed. The mesoglœa also contains in certain regions fibres and cells. The fibres the author believes to be the means of communication between ectoderm and muscles, and therefore to be of the nature of nerves. The cells are connective tissue cells, probably originating from the ectoderm. On account of the bad preservation little could be made of the ectoderm. The cells on the tentacles and in the region of the disc were filled with zooxanthellæ. The author believes that the ectoderm-cells of the upper part of the wall of the polyps take up the foreign particles which fill the mesoglœa, just as the cells of the tentacles and disc take up zooxanthellæ. Practically nothing was made of the endoderm.

The other form, apparently *Gemmaria variabilis* Duerd., is likewise colonial and incrusted. The incrustation is confined to the walls of the polyps, and cœnochyme is absent between them, so that they are attached only by a basal sheet. Zooxanthellæ are abundant in the ectoderm, but the abundance of sand-particles made an investigation of the histology impossible.

Regeneration in Hydra.†—H. W. Rand finds that when a number of individuals of *H. viridis* are bereft of their tentacles, the number of regenerated tentacles is always rather less than the original sum. The difference between the original average number of tentacles and the average number of regenerated tentacles is greater in proportion to the original number. The number of regenerated tentacles seems to depend in part on the size of the fragment. A whole polyp regenerates more than a half does, and a half more than a quarter. In cases of longitudinal halving the original number is restored by each half. Like other modern experimenters, Rand failed to rear a polyp from an isolated tentacle, as Rösel von Rosenhof says he did with *H. grisea.* The author discusses also the "regulative processes" in regeneration.

Loss of Ectoderm in Hydra viridis.‡—Mr. W. L. Tower has observed a very curious reaction in hydra when placed on the stage of a

* Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 269–88 (2 pls.).
† Arch. Entwickmech., viii. (1899) pp. 1–34 (4 pls.). See Zool. Centralbl., vi. (1899) pp. 385–6.
‡ Amer. Nat., xxxiii. (1899) pp. 505–9 (2 figs.).

projection Microscope. The apparatus consisted of an alternating current arc-lamp of fifty-two volt twelve ampere capacity. The light was taken by a pair of 4½-in. condensers, and was passed through an alum cell, a biconvex condensing lens, an Abbe condenser, and finally to the objective. When a healthy unstimulated *Hydra* was placed in the field, it underwent violent contraction, discharged its stinging cells, and began to lose its ectoderm cells. The whole of the ectoderm was lost in a period varying from one to eleven minutes. When the polyps were placed in fresh water, they recovered the ectoderm in a period varying from nine to thirty-three days. The dropping-off of the ectoderm cells resembled in some ways the blistering effects produced on the human skin by the Röntgen rays. These rays are present in small quantity in the light from an arc-lamp.

Species and Environment in Hydroids.*—Herr A. Birula has noted some interesting environmental variations in *Campanularia*. Two species, *C. integra* MacGillivray and *C. caliculata* Hincks, were united by Levinsen on account of the existence of numerous transitional forms between them. Birula finds that the second inhabits shallow water, and that its peculiarities seem to have a direct relation to the force of the currents. Its calyx is of oval form and thickened at the poles, and the colonies grow so that the thickened areas receive the force of the current. The typical form, *C. integra*, grows in deep water where currents are not felt, and has a uniformly rounded thin-walled calyx. Somewhat similar conditions exist in *Sertularella tricuspidata*; while in other cases different species inhabit deep and shallow water. Both in the cases of *Campanularia integra* and of *Sertularella tricuspidata*, the intermediate depths are occupied by transitional forms.

New Family of Palæozoic Corals.†—Mr. Amadeus W. Grabau proposes the new family Moniloporidæ for the two genera *Monilopora* and *Ceratopora*, each represented by several species, and forming a natural association, with features which separate them from other Palæozoic corals. The earlier of the two genera is *Ceratopora*, and it is less specialised in structure. The diagnosis of the new family is as follows:—Compound branching coralla, composed of cylindrical or funnel-shaped corallites, which either remain connected by their visceral cavities, or become separated within by the disposition of continuous layers of sclerenchyma; tabulæ absent; walls thickened by the addition internally of concentric layers of sclerenchyma, which either are closely applied or leave variously shaped cavities or lacunæ between successive layers; septa absent, or represented by costæ and trabeculæ; asexual reproduction by basal and lateral gemmation; range from Devonian to Carboniferous.

Porifera.

Geographical Distribution of European Spongillidæ.‡—Dr. Paul Girod takes a survey, and concludes that there are five main European forms, namely, those found in France—*Spongilla lacustris*, *Sp. fragilis*,

* Ann. Mus. Zool. St. Pétersbourg, 1898, pp. 203–14 (Russian). German abstract in Zool. Centralbl., vi. (1899) pp. 518–9.
† Proc. Boston Soc. Nat. Hist., xxviii. (1899) pp. 409–24.
‡ Bull. Soc. Zool. France, xxiv. (1899) pp. 51–3.

Trochospongilla horrida, *Ephydatia fluviatilis*, and *E. mülleri*—to which must be added *Carterius stepanowi* for eastern Europe. The other species are localised in widely separate haunts, and may be regarded as secondary.

Ephydatia bohemica Petr.* —Dr. Paul Girod gives reasons for transferring this species to the genus *Carterius*, and suggests that further investigation may show its identity with *C. stepanowi.*

Protozoa.

Physiology of Paramæcium.†—Mr. H. S. Jennings, in the course of his observations on the reaction to stimuli of unicellular organisms, has made some interesting experiments on the motor reactions of *Paramæcium* and their mechanism. He finds that this organism has a single motor reaction by which it responds to all classes of stimuli. The reaction is such that the direction of movement is reversed, the animal is driven backward, and then swings round to the aboral side. When a change of direction has been thus accomplished, the animal returns to the ordinary forward movement. The intensity of the different parts of the reaction varies with the intensity of the stimulus. The reaction occurs in the same way whether the stimulus acts on a special part of the organism or on the whole surface at once; that is, *Paramæcium* does not turn directly towards a beneficial source of stimulus or away from an injurious one, but has one method of reaction determined by its structure. The terms positive and negative taxis cannot strictly be applied to *Paramæcium*, for it cannot be said to be directly attracted or repelled by certain agencies or conditions. The swarming near beneficial sources of stimuli is not active, but is due to the fact that these sources cause no motor reactions. In general the movements of *Paramæcium* seem to be merely the result of its power of responding to a stimulus by one fixed and definite reaction.

In another paper the author considers the laws of chemotaxis in *Paramœcium*, the expressions positive and negative chemotaxis being used not in any exact sense, but merely to designate the results produced by attractive or repellent substances when introduced into the medium in which the organisms are living. He finds that chemotaxic substances produce the same motor reactions as mechanical shock or any other stimulus, and that this motor reaction is the same whatever the position of the reagent or of the organism, so that a chemical which, acting on the anterior end of the organism produces positive chemotaxis, will produce negative chemotaxis when acting on the posterior end. The organisms are most nearly at rest in a weakly acid solution, and collect in weakly acid solutions; hence their positive chemotaxis towards nutritive substances such as meat extract. The chief factor causing the motor reaction which results in negative chemotaxis, is not the injuriousness of the substance, but is of a chemical nature, equally injurious substances not having equally repellent powers.

Fresh-water Protozoa.‡—Dr. Robert Lauterborn describes a number of new or little-known forms. In a pond at Maudach he found a curious

* Bull. Soc. Zool. France, xxiv. (1899) pp. 54–6.
† Amer. Journ. Physiol, ii. (1899) pp. 311–40 (15 figs.) and 355–79.
‡ Zeitschr. f. wiss. Zool., lxv. (1899) pp. 369–91 (2 pls.).

colonial form which he calls *Sphæræca volvox.* The colony consists of numerous choanoflagellate individuals, and seems to be most nearly related to the genus *Protospongia.* A new species of *Bicosœca—B. socialis*—was found, which differs from all other species in being free-swimming instead of fixed. The individuals are loosely attached together to form star-shaped colonies, in which each individual is furnished with a hyaline investment. The peculiarities of the "stalk," by means of which the organism is attached to its investment, show that this is to be regarded as a modified second flagellum, equivalent to the trailing flagellum of the Heteromastigodes. Another very remarkable form, to which the name of *Thaumatomastix setiferum* was given, has its surface furnished with numerous scattered bristles. It has also two flagella of unequal size, but was observed at times to emit pseudopodia, a very remarkable circumstance in a form apparently so highly specialised. There is no mouth, and the pseudopodia must be used in food-catching. The paper includes descriptions of several other new forms.

Notes on Protozoa.*—Herr S. Prowazek sums up the results of his experiments on the *intra vitam* staining of Protozoa with neutral red. He also describes the cyst of a *Paramæcium* and the emergence of the animal, the conjugation of three individuals of *Cyclidium glaucoma*, the alteration in the rate of the contractile vacuole's pulsations in dividing Infusorians, and so on.

New Peridiniaceæ from the Atlantic.†—Mr. George Murray and Miss Frances Whitting publish specific descriptions of the Peridiniaceæ collected by the pumping method during various Atlantic journeys. The paper is of interest because it is the first attempt which has been made to draw up specific diagnoses for the group. The paper includes elaborate tables of distribution.

Development of Fresh-water Peridiniaceæ.‡—Dr. V. Folgner has been able to make a series of observations on this subject. The first material obtained consisted of winter cysts of *Ceratium tetraceros.* These were received in the middle of October, and in a window protected from frost the organisms began to leave their cysts in the second half of February. The actual rupture of the cysts was not observed, but the newly hatched individuals were somewhat egg-shaped structures without horns or membranous investment, but with a distinct transverse furrow. The protoplasm was dark in colour owing to the compacted chromatophores. Soon after hatching the organisms displayed a slow circular movement, the swinging movement being accompanied by amœboid changes of form. In addition to these temporary changes, the body shows a gradual but permanent alteration, so that the ovoid shape is lost, the anterior and posterior horns grow out, the membrane becomes distinct and acquires its sculpturing, and at the end of about six hours the animal acquires the characteristics of the "spring form" as it occurs in natural condition. This form differs from the autumnal one in the greater simplicity of the investment, and the entire absence of the third horn. The author does not believe that a true seasonal dimorphism exists,

* Zool. Anzeig., xxii. (1899) pp. 339–45 (1 fig.).
† Trans. Linn. Soc. (Botany), v. (1899) pp. 321–42 (7 pls.).
‡ Oesterr. Bot. Zeitschr., xlix. (1899) pp. 81–9, 136–41, 221–6, 257–61 (1 pl.).

but rather that the individuals undergo a slow development during the warm months. The author found that in all his specimens two longitudinal flagella developed simultaneously at an early stage; these flagella have been seen by other authors, but only as an occasional abnormality. Another peculiarity not hitherto observed is that the longitudinal flagella sometimes expand at their ends into little vesicles of varying size and number. These are probably to be regarded as degeneration products due to the dying of the flagella.

Green Amœbæ.*—Prof. A. Gruber describes a case in which a colony of *Amœba* and *Paramæcium bursaria* flourished for about seven years without animal food, in virtue of their partnership with zoochlorellæ, which sustained a holophytic mode of nutrition.

Myxosporidia.†—Dr. Fr. Doflein gives a useful summary of recent contributions to our knowledge of Myxosporidia. They are Rhizopod-like parasites found especially in fishes and Arthropods; occurring in almost all kinds of tissue, in cysts, in diffuse infiltration, or within the cells; propagating themselves by means of spores, and also in some cases multiplying within their host by multiple plasmotomy or otherwise, causing a variety of diseases, such as the pébrine of silkworms (due to *Glugea bombycis*) and the *Pockenkrankheit* of carp (due to *Myxobolus pfeifferi*). They are usually referred to the Sporozoa, but the author lays stress on their Rhizopod affinities, and on the approximation of Rhizopods and Sporozoa.

* Ber. Nat. Ges. Freiburg i. Br., xi. (1899) pp. 59–61.
† Zool. Centralbl., vi. (1899) pp. 361–79 (9 figs.).

BOTANY.

A. GENERAL, including the Anatomy and Physiology of the Phanerogamia.

a. Anatomy.

(1) Cell-Structure and Protoplasm.

Chemical Energy of Living Cells.* — Herr O. Loew further discusses the energy of living protoplasm, giving the results of a large number of recent observations. The present volume treats of the causes of vital activity, the general characteristics of living substance, its chemico-physiological characteristics, the essential accompaniments of protoplasm, the character of biochemical work, the formation of albumen in the lower fungi and in chlorophyllous plants, the theory of the formation of albumen, a transient proteinaceous substance as a reserve-substance in plants, the chemical characteristics of proto-protein, motility and activity in protoplasm, the theory of respiration. The motility of protoplasm is brought about by the concurrence of aldehyd and amide-groups; the oxydases cannot be regarded as the source of respiration.

Periplasmic Membrane.†—M. M. Tswett contests the conclusions to which Chodat and Boubier have come ‡ with regard to the ectoplasmic layer or parietal utricle of living cells. In opposition to them, he maintains his previous view that this periplasmic layer is not merely a molecular layer, but is a distinctly differentiated membrane, an organ of the cell. Although there is a distinct adherence between this membrane and the underlying hyaloplasm, this does not imply any insensible transition from one to the other.

Kinesis in the Pollen-grains of the Liliaceæ.§ — M. V. Grégoire differs from previous observers — Farmer, Mottier, Strasburger, and Sargant—with regard to the processes which take place in the formation of the pollen-grains of *Lilium*. He states that the kineses are accompanied by two longitudinal divisions at right angles to one another, and pre-arranged, from the first kinesis, by the formation of tetrads. The chromosomes do not undergo any transverse division, and there is therefore no reduction division in Weismann's sense. The bodies described by some writers as centrosomes he believes to be nucleoles.

Nuclear and Cell-division in Solanum tuberosum.‖—Dr. B. Němec has followed out these processes in the apices of the stem and root of the potato, and in the tuber during the formation of the periderm resulting from injury. The differences in the development of the achromatic division-figure are of great interest, showing distinctly that even in the vegetative tissue of the same plant the development of the achromatic figure may differ in essential particulars, and that external

* 'Die chemische Energie d. lebenden Zellen,' München, 1899, xi. and 175 pp. See Bot. Centralbl., lxxviii. (1899) p. 341.

† Journ. de Bot. (Morot), xiii. (1899) pp. 79–82.

‡ Cf. this Journal, 1898, p. 637.

§ Bot. Centralbl., lxxviii. (1899) pp. 1–3.

‖ Flora, lxxxvi. (1899) pp. 214–27 (2 pls. and 9 figs.).

conditions must be taken into account in order to explain the causes of these variations. The nuclear divisions in the vegetative tissue of the apex of the stem and root follow the ordinary course, and are described in detail; as are also the processes in the periderm formed as the result of injury to the tuber. The development of the achromatic fibres corresponds in many respects to that described by Mitzkewitsch * in the case of *Spirogyra*. It is monaxial and acentric, there being no indication of an extra-nuclear centre. During the whole of the division the fibres which run to the pole at no time unite into a single point, but all develop from the first in the direction of the division-axis.

The differences between the two kinds of nuclear division in the potato chiefly relate to the development of the achromatic figure. While in the apex of the stem or root a hyaline periplast arises of bipolar form, on the periphery of which are formed fibres which run meridionally round the nucleus; in the divisions, on the other hand, on the surface of a wound to the tuber, the fibres grow directly from the surface of the nucleus, both under normal conditions and when the cells are subjected to strain or pressure. As a rule, the number of chromosomes in the figures is greater in the latter than in the former case.

Artificial Production of the Sickle-stage of the Nucleole.†—Mr. J. H. Schaffner, after using the following mixture:—alcohol 95 ccm., chloroform 5 ccm., glacial acetic acid 1 ccm., chromic acid 1 per cent. 1 ccm., for killing the root-tips of the common onion, found that the cells were badly shrunken, the nuclei displaced, and the cytoplasm more or less distorted. Nearly all the nuclei of the cells of the peripheral layers showed the sickle-stage. In the central cells there was little displacement, though the cells were much shrunken.

The inference from the foregoing facts is that the sickle-stage is an artificial production.

(2) Other Cell-Contents (including Secretions).

Aldehyd in Green Leaves.‡—Prof. J. Reinke and Herr E. Braunmüller have carried on a series of experiments on different plants to determine the effect of light on the amount of [formic] aldehyd contained in green leaves. The results were not uniform; but the general conclusion was that, in most cases, deprivation of light caused a distinct diminution in the amount of aldehyd. The test employed was precipitation by metanitrobenzhydrazid. The authors conclude that aldehyd is probably not the first product of assimilation, but that, whatever this may be, it is, in the majority of cases, first condensed into sugar, in other cases into "leaf-aldehyd."

Origin of Storax.§—Herr J. Moeller, who has been occupied for the past twenty years in studying the origin and development of storax, recently showed that this balsam is not produced in the bark, but is formed in the wood; that it is not a physiological secretion, but a pathological product which arises after damage to bark or wood.

* Cf. this Journal, 1898, p. 567.
† Journ. Applied Microscopy, ii. (1899) pp. 321–2 (8 figs.).
‡ Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 7–12.
§ XII. Congrès Internat. d. Med. à Moscou, sect. iv. See Centralbl. Bakt. u. Par., 2te Abt., v. (1899) p. 412.

The first effect of a wound is the development of schizogenous glands which are subsequently converted into lysigenous spaces. These facts were verified both for styrax liquidus from *Liquidambar orientalis*, and for sweet gum from *Liquidambar styraciflua*. The experimental proof was furnished by L. Planchon, who found that balsam did not exist in normal plants, and that it occurred only after wounding the tree.

The author supports this by noting the result of making semicircular cuts in a *Liquidambar styraciflua* 6 metres high. Where the branches were not wounded there was no trace of balsam; but where the damage had affected the cambium, rows of balsam glands could be detected with a lens. It seems therefore indisputable that storax is a pathological product.

Cellulose Enzymes.*—Prof. F. C. Newcombe has made a series of experiments on those enzymes which have the capacity of dissolving reserve-cellulose or starch (cytases or diastases). The following are the more important results.

The enzyme extracted from *Aspergillus Oryzæ* attacks reserve-cellulose with greater intensity than it attacks starch. The enzyme from the cotyledons of seedlings of *Lupinus albus* is very strongly cytohydrolytic, but very feebly amylohydrolytic. The same is the case with the enzyme from the cotyledons of seedlings, and from the endosperm of *Phœnix dactylifera*. These enzymes act so feebly on starch, and so energetically on reserve-cellulose, that they may be regarded as cytases as distinguished from diastases. The very dilute enzyme of the malt of barley attacks reserve-cellulose. With all the enzymes examined (those of *Aspergillus Oryzæ*, *Phœnix dactylifera*, *Fagopyrum esculentum*, *Pisum sativum*, and *Lupinus albus*), the walls of the cells attacked become at first hyaline and gradually more and more transparent, finally disappearing altogether in solution.

(3) Structure of Tissues.

Elastic Swelling of Tissues.†—Herr C. Steinbrinck discusses, from a physical point of view, the phenomena connected with the curvature of the tissues in the bursting of anthers, and of the sporanges of ferns, *Equisetum*, &c.

Physics of Cohesion-Mechanism.‡—Herr C. Steinbrinck treats this subject from a mathematical point of view. With regard to the pappus of the Cynareæ, he agrees with Zimmermann, and with a paper (in Russian) by Taliew, that the movement of the hairs is not merely a passive one, but that they have in themselves a "shrinking-mechanism," which can be demonstrated, by their optical phenomena in polarised light, to be due to the structure of their cell-membranes. In the majority of the Compositæ this mechanism is, however, rudimentary; the greater part of the movement is due to the "cohesion-mechanism" of the cushion which bears the hairs. This cushion is well described by Taliew. In the contraction of tissues, the force which drives the water into the contracted cells, and smooths out the folds in their walls

* Ann. of Bot., xiii. (1899) pp. 49–81.
† Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 99–112.
‡ Tom. cit., pp. 170–8.

so as to restore them to somewhat their original size, is the excess of the inner pressure in the water without, over that in the water within the cells.

Mucilage as a Gliding-mechanism.*—Dr. F. W. T. Hunger points out that mucilage, in addition to its protective function in the vegetable kingdom, has another purpose, analogous to that in animals, to allow newly formed organs to glide over one another without injury in rapid growth, or to promote the power of motility in parts of plants or in entire organisms. The following illustrations, among others, are given:—The mucilaginous envelope of the Oscillatoriaceæ, of diatoms and desmids, and of the hormogones in the Cyanophyceæ; the large development of mucilage in the Florideæ; the invariable development of mucilage in the growing point and round the sexual organs of the Hepaticæ; the mucilaginous coating of root-tips and root-hairs; the secretion of mucilage in the leaf-sheaths of the Polygonaceæ and of many other plants.

Conducting Tissue of Vanilla Fruit.†—Herr A. Tschirch has made a careful study of the so-called "tela conductrix" of the fruit of the vanilla, and decides that it is a true conducting tissue, through which the pollen-tubes penetrate. Not only the outer but also the lateral walls of the epidermal cells which face the ovary, are converted into mucilage, the pollen-tubes passing through the gelified cell-walls.

(4) Structure of Organs.

Colours of Flowers.‡—From an examination of a number of monocotyledonous flowers of North America, Mr. J. H. Lovell comes to the conclusion that the primitive colour of the perianth of monocotyledonous flowers was green. Yellow, white, and lurid or greenish-purple flowers have in many instances been derived directly from the primitive green; red flowers have passed through a yellow or white stage; blue and purple-blue have been derived from yellow, white, or red forms. In general, among monocotyledons, yellow flowers are visited by flies and bees; white flowers by bees, nocturnal Lepidoptera, flies, and beetles; lurid-purple by flesh-flies; red by bees and butterflies; blue flowers chiefly by bees. Red and blue flowers usually have the honey concealed, which is a far more effective cause of the limitation of insect visits than colour.

Periodicity in the Flowering of Dendrobium crumenatum.§—M. F. A. F. C. Went describes the phenomena connected with the opening of the flower of this epiphytic Orchid of Java. Not only all the flowers of an inflorescence, but all the flowers on the different plants in the same district, are open, as a rule, on the same day, withering in the evening, whether growing in the sun or the shade. He regards this periodicity as due to internal causes, but modified and defined by external conditions.

* Biol. Centralbl., xix. (1899) pp. 385–95.
† Schweiz. Wochenschr. f. Chemie u. Pharm., 1898, No. 12. See Bot. Centralbl., lxxviii. (1899) pp. 105–8 (3 figs.).
‡ Amer. Nat., xxxiii. (1899) pp. 493–504.
§ Ann. Jard. Bot. Buitenzorg, 1898, 2me Suppl., pp. 73–7.

Ovule and Seed of Rafflesia and Brugmansia.* — Graf zu Solms Laubach has studied the development of the ovule and seed in these two genera. The ovules arise on the walls of the fissures of the ovary in the ordinary way as conical projections, but before the complete differentiation of the epiderm. The apex of the curved ovular cone becomes the nucellus; the embryo-sac originates from the terminal cell of its central row. As in the Orchideæ, the ovules are not fully developed at the time of opening of the flower; it is only later that the germinal vesicles and antipodals make their appearance; probably only after pollination. The endosperm originates in the ordinary way; not, as in many other parasites, by division of the embryo-sac. The embryo finally absorbs the endosperm, with the exception of its outermost layer, which remains firmly attached to the seed till maturity.

Hygroscopic Mechanism of Anthers and Hairs.†—Herr C. Steinbrinck now attributes the bending of the outer tangential walls of anther-cells to the pressure of water rather than to the shrinking of the radial wall; the inner tangential walls offering a greater resistance to this pressure. In the peristome of mosses, the movement is rather due to a shrinking of the cell-wall. A similar phenomenon is observable in hygroscopic hairs, such as those of the seeds of *Salix* and *Populus*, those on the style of *Clematis* and *Pulsatilla*, the primary rays of the pappus of Compositæ, the awns of *Pelargonium* and *Erodium*, and the hairs on the seed-vessel of *Geranium sanguineum*.

Mucilage of the Seeds of Cistaceæ.‡—Herr O. Rosenberg arranges the species of Cistaceæ in seven groups dependent on the origin of the mucilage in the testa which varies greatly. It may result from the gelification of the outer side of the cuticle, or from that of the inner layers of the wall; in *Fumana* from the gelification of all the walls of the epidermal cells. In the section Euhelianthemum there is an internal as well as an external mucilage. In the testa of the seeds of most Cistaceæ starch is found, which the author regards as a product of excretion. It appears to take no part in the metastasis which accompanies germination.

Convolute Cotyledons.§—Herr F. Hegelmaier has followed out the development of convolute cotyledons, especially in the Geraniaceæ and Onagraceæ. It does not appear to depend on any obvious mechanical cause. The embryo is neither strictly incumbent nor strictly accumbent, though approaching more nearly to the latter position. The convolute folding of the cotyledons is evident from the time that they are still small—not more than 0·3 mm. broad—their margins being at a considerable distance from the testa, and the endosperm has no influence on their development. Both the cotyledons develop unequally on the two sides, sometimes the right, sometimes the left side, but always the same for the two cotyledons.

* Ann. Jard. Bot. Buitenzorg, 1898, 2me Suppl., pp. 11–21 (1 pl.).
† 'Ueb. d. hygroskopischen Mechanismus v. Staubbeuteln u. Pflanzenhaaren,' 1899 (1 pl.). See Bot. Centralbl., lxxviii. (1899) p. 343.
‡ Bih. k. Svensk. Vetensk.-Akad. Handl. Stockholm, xxiv. (1898) Afd. 3, 60 pp. (2 pls. and 5 figs.).
§ Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 121–39 (1 pl.).

False Dichotomy.*—Herr J. Wiesner describes an example of this mode of branching in *Xanthophyllum vitellinum*. He also gives further illustrations of his classification of the various modes of the branching of lateral shoots under three heads, viz.:—(1) *epitrophic*, the stronger growth of the lateral shoot which springs from the upper side of a lateral mother-shoot; (2) *hypotrophic*, the stronger growth of the lower lateral shoot of an inclined mother-shoot; (3) *amphitrophic*, the stronger growth of a lateral shoot of an inclined mother-shoot.

Anatomy of Leaves.† — M. E. Pée-Laby has made an exhaustive study of the anatomical structure of the leaves of grasses, natives of France, which he classifies under six categories. The characters of these six classes are described in detail, as respects the epiderm, the chlorophyllous parenchyme, the veins, and the supporting tissue.

Hydathodes of Conocephalus ovatus.‡—Herr G. Haberlandt states that if the normal hydathodes of this plant, belonging to the Urticaceæ, are destroyed, there appear, on the under side of the leaves, bladders, caused by the raising up of the epiderm, which performs the same function in taking up an excess of water.

Stomates of Monocotyledons.§—Herr H. Miehe confirms, in all essential points, Strasburger's account of the processes of cell-division which take place in the formation of the stomates in Monocotyledons (*Iris*). The mother-cell of the stomate arises from the division of an epidermal cell into a larger and a smaller cell, the two guard-cells being then formed by a longitudinal division of the latter. The nucleus of the epidermal cell moves towards one end of the cell, where the mother-cell of the stomate originates, and the nucleus of the larger half then returns to the centre. The mother-cell of the stomate is always separated from the end of the epidermal cell nearest to the apex of the leaf. Herr Miehe now describes the process in great detail, and states that, although the two cells are so unequal in size, the amount of protoplasm in the two is about the same. The movement of the nucleus cannot be explained, in the opinion of the author, by physical causes (gravitation). It depends on the fact (as can be clearly seen in *Hyacinthus*) that the nucleus of epidermal cells is connected with the parietal layer by strands of protoplasm; and this also accounts for the fusiform shape of the nucleus. The wall of the nucleus is stated to be composed of kinoplasm.

Trichomes of the Gesneraceæ.‖ — Dr. K. Rechinger describes the remarkable trichomic structures which are found in many genera of Gesneraceæ, as a type of which may be taken those of *Smithiantha cinnabarina*, the chief characteristic being the partial or entire filling up of the terminal cell by a hyaline mass. They do not occur in all the genera, and the variations in their form and structure are described in as many as 83 different species. The cell-walls of the swollen cells may or may not be thickened.

* Ann. Jard. Bot. Buitenzorg, 1898, 2^me Suppl., pp. 97–102 (1 pl.).
† Ann. Sci. Nat. (Bot.), viii. (1898) pp. 227–346 (4 pls. and 18 figs.).
‡ 'Ueb. experimentelle Hervorrufung eines neuen Organes bei Conocephalus ovatus,' Berlin, 1899, 119 pp. and 2 figs. See Bot. Ztg., lvii. (1899) p. 211.
§ Bot. Centralbl., lxxviii. (1899) pp. 321–30, 353–9, 385–93 (1 pl.).
‖ Oesterr. Bot. Zeitschr., xlix. (1899) pp. 89–92, 142–6, 180–3, 207–13 (1 pl.).

Structure of Hypecoum.*—Prof. E. Martel discusses the structure and affinities of this genus, intermediate between the Fumariaceæ and the Papaveraceæ. He finds it to exhibit very much the original types from which the Cruciferæ must have sprung. The sepals appear to be organs in the course of atrophy; the stamens belong to two distinct whorls.

β. Physiology.

(1) Reproduction and Embryology.

Embryo-sac of Monocotyledons.†—Dr. K. M. Wiegand has shown that the two extreme types of embryo-sac formation, as illustrated by *Lilium* and *Canna*, are connected in a manner not before observed. In *Convallaria*, which represents the transitional type, a septum is formed after the first division of the hypodermal nucleus, but not after the second. This represents an axial row of 4 cells with 2 septa omitted. The remaining septum at length breaks down, so that a single cavity results containing 8 nuclei. The single cell of *Lilium* is therefore derived from the 4 axial cells of *Canna*, not primarily through the absence of any divisions of the mother-cell, but by the absence of the septa.

Embryology of Taxus.‡—The development of the female prothallium of *Taxus* has been traced by Mr. E. J. Durand from one cell of an initial axial row of about three cells. The nuclei which result from the division of that of the megaspore arrange themselves in a peripheral layer, and walls are formed between them, so that the young prothallium has the form of a hollow sphere. The hollow centre gradually becomes solid from the ingrowth of the cells. The archegones are developed at the distal end of the prothallium. The neck consists of four cells, not of one, as usually stated.

Development of the Pollen-grain in Symplocarpus and Peltandra.§—Mr. B. M. Duggar has investigated the development of the pollen-grains in these genera, belonging to the Araceæ. Division in the primitive archespore is of the vegetative type, and the number of chromosomes is that of the whole number of the sporophyte. Synapsis, or the contracted state of the chromatin thread in the late reticulum or early spirem, was found abundantly at a definite period in the life-history of these cells prior to actual division. The formation of the spindle is multipolar. The first division in general indicates that there is a longitudinal division of the chromosomes. In the second division the daughter segments separate longitudinally. There is no return of the nucleole prior to the second division, but a true dispirem is formed. In the division of the microspore nucleus, the nucleus first migrates to one side of the cell, and the entering kinoplasm forms a multipolar somewhat barrel-shaped spindle. This finally becomes completely attached at one pole, forming a truncated cone, while the other pole of the spindle may be completely conical.

* Mem. R. Accad. Sci. Torino, xlviii. (1899) pp. 209–20 (2 pls.).
† Proc. Amer. Ass. Adv. Sci., xlvii. (1898) p. 430.
‡ Tom. cit., p. 430. § Tom. cit., pp. 429–30.

Physiology of the Flower of Victoria regia.*—Herr E. Knoch finds a gradual passage from the fertile stamens in this water-lily to the paracarpels, which must be regarded as staminodes. Their origin coincides altogether with that of the stamens. When the flower opens, it emits a strong odour, and gives out a large amount of heat. Insects, which appear to be necessary for pollination, are thus attracted, and are detained by the bending over of the stamens and staminodes until the anthers are discharging their pollen. The flower then again opens, and the insects carry the pollen to other flowers. The source of the elevation of the temperature lies in the stamens, the staminodes, and the appendages to the carpels, chiefly in the latter. The odour commences at the same time, and is due to the action of oxygen on the cells of the staminodes.

Cross-Pollination and Self-Pollination.—Herr O. Ekstam † finds, in the flora of Spitzbergen, but very few species which are entirely dependent on insects for their pollination, though a considerable number are ordinarily cross-pollinated. The flowers are not larger, but are more brightly coloured, than those of lower latitudes. As in Nova Zembla, the proportion of scented species (with few exceptions an agreeable odour) is very large, amounting to about 20 per cent.

Mr. A. G. Hamilton ‡ describes the mode of pollination in a number of American plants. In *Erythrina indica* (Leguminosæ) the carriage of pollen is effected by birds in search of honey, chiefly several species of *Ptilotis*.

According to Herr G. Volkens,§ ornithophily is a widely distributed phenomenon in the Kilmandscharo flora. He records this especially in the cases of *Loranthus Ehlersii*, *laciniatus*, and *undulatus*, and *Protea Kilimandscharica*. The pollinating birds are the honey-birds, which in Africa represent the American humming-birds.

(2) Nutrition and Growth (including Germination, and Movements of Fluids).

Symbiotic Saprophytism.‖—Prof. D. T. MacDougal discusses the biological relationship of saprophyte to host in the case of a large number of American host-plants, and arrives at the following general conclusions.

Saprophytism is an adaptation of the absorbent mechanism, or of the character of the metabolic capacity of an organism. Symbiotic saprophytism is the natural result of the supplemental capacities of two organisms brought into nutritive contact chemotropically. The Fungi which form mycorhiza are capable of independent existence, and undergo modifications of the hyphæ and reproductive organs in

* 'Unters. üb. d. Morphologie, Biologie, u. Physiologie d. Blüten v. Victoria regia,' Marburg, 1897, 56 pp. See Bot. Centralbl., lxxviii. (1899) p. 183.

† Tromsö Mus. Aarsk., xx. (1897) 66 pp. See Bot. Centralbl., lxxviii. (1899) p. 51. Cf. this Journal, 1898, p. 444.

‡ Proc. Linn. Soc. N.S. Wales, 1898, pp. 759–66 (1 pl.).

§ 'Ueb. d. Bestäubung einiger Loranthaceen u. Proteaceen,' Berlin, 1899, 20 pp. and 1 pl. See Bot. Ztg., lvii. (1899) 2te Abth., p. 215.

‖ Ann. of Bot., xiii. (1899) pp. 1–47 (2 pls. and 1 fig.).

the portion of the mycele in contact with the protoplasm of the host-plant. Sporangioles, vesicles, and hyphal clumps are organs of nutritive interchange. The changes in the host-plant are of two kinds, degeneration of normal structure, and the formation of special cells for the accommodation of the Fungus. The velamen of terrestrial and aerial roots (Orchideæ, &c.), and the trichomes of coralloid structures, are devices which facilitate absorption by endotropic Fungi. Mycorhizal Fungi sometimes penetrate non-absorbing organs. The acquisition of the habit of symbiotic saprophytism renders a group of plants extremely unstable as to specific characters. The penetration of non-absorbent organs by the fungal symbiont affords opportunity for the utilisation of these organs for absorption in case of a diminished supply of food from the ordinary sources. There are but few constant anatomical characters indicative of partial or complete saprophytism. Absence of chlorophyll is the only invariable accompaniment of holosaprophytism; while degeneration or alteration of the stele is not always consequent. In the formation of mycorhiza, the fungus may be associated with prothallia, roots, or stems.

Variation in the Graft, and Inheritance of Acquired Characters.*—M. L. Daniel gives the result of a very large number of experiments on the grafting of herbaceous and woody plants. The phenomena of grafting afford no exception to the general rule of the influence exerted on the development of a plant by its external conditions, and especially by those connected with the supply of nutriment; but this influence is not invariably exerted. These acquired characters of the graft may be exhibited only in the seed and embryo, and the author sums up strongly in favour of their perpetuation by heredity. The effect of grafting may be either the fixing and perpetuation of varieties or races already in existence, or—and this is especially the case with herbaceous plants—it may be the direct production of new varieties, and hence the actual improvement of the race.

Physiology of Roots.†—Herr A. Rimpach classifies roots under four heads, viz. (1) Nutrient Roots, whose sole function is the conveyance of food-material to the rest of the plant. The central bundle, which consists chiefly or exclusively of conducting elements, is surrounded by a comparatively insignificant cortical parenchyme, which may entirely disappear. (2) Firm Attachment-Roots. These do not store up food-material, are not contractile, and the conveyance of food-material is so unimportant that their sole or chief function may be regarded as the fixing of the plant to the substratum. They are characterised by the large development of stereome, and are especially characteristic of the epiphytic Bromeliaceæ, Araceæ, and Cyclantheæ, and of the terrestrial Bromeliaceæ, Gramineæ, and Palmæ. (3) Contractile Roots ‡ (*Zugwurzeln*). These contain few or no stereids, while the thin-walled parenchyme is relatively well developed and permanent. Contractile roots may or may not be also organs of storage. (4) Storage-Roots. The structure of these roots agrees with that of other organs used for

* Ann. Sci. Nat. (Bot.), viii. (1898) pp. 1–226 (10 pls. and 19 figs.).
† Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 18–35 (1 pl.).
‡ Cf. this Journal, 1897, p. 551.

the same purpose; they consist chiefly of a permanent parenchyme filled with food-material, and may be swollen into the form of a tuber.

The roots of herbaceous plants may live only for a single year or for several years, or may have an apparently perennial existence. They may be produced only at one or at two different periods in the same year. The same species may have more than one kind of root, and these may or may not pass into one another by insensible gradations.

Absorption of Nitrogen by Plants.*—From experiments made on *Pisum sativum*, *Polygonum Fagopyrum*, *Avena sativa*, and *Sinapis alba*, Herr L. Richter concludes that of these plants, the pea only, and not mustard, buckwheat, or oat, has the power of making direct use of the free nitrogen of the air; and that this power is independent of the tubercles. Combination with nitrogen in the soil takes place where there is otherwise a deficiency of assimilable nitrogen.

Germination of Anemone apennina.†—Herr F. Hildebrand notes some remarkable peculiarities in the germination of this plant. The lower part of the stem of the cotyledons has all the appearance and functions of a root, being densely covered with hairs. At the base of this hairy structure appears a slight swelling, which gradually increases in size into the appearance of a tuber. Both the upper smooth and the lower hairy portion of the axis increase in length, so that the tuberous structure is forced lower and lower into the soil. The first leaf now makes its appearance, not between the two cotyledons, but on the upper surface of the tuber, by the side of the cotyledonary stalk; while a few secondary roots are put out laterally from the primary one. Between the cotyledonary stalk and the first leaf is the true apex of the ascending axis, from which are developed the remaining leaves in the following year.

Germination of Heritiera littoralis.‡—M. J. G. Boerlage describes the contrivances by which the seeds of this tree, belonging to the Sterculiaceæ, and widely distributed on the shores of the Eastern Archipelago, are protected from the injurious effect of sea-water, when the fruit falls into the sea, permitting them to escape only when thrown up on the shore.

Bleeding of Woody Plants.—Prof. H. Molisch has made a variety of observations on the flow of sap from the stem of woody plants when wounded.

In the case of palms §—*Cocos* and *Arenga*—the bleeding, when the inflorescence is amputated, is not due to root-pressure. No sap escapes from borings at the base of the stem, though it pours out abundantly at higher parts, even at a height of 19–28 m., when the tree is in full leaf. The spadix continues to bleed for one or two days after being amputated. The origin of the osmotic pressure appears, there-

* Landwirtsch. Vers.-Stat., li. (1898) pp. 221 *et seq.* See Bot. Centralbl., lxxviii. (1899) p. 90.

† Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 161–6 (1 pl.). Cf. this Journal, 1892, p. 390.

‡ Ann. Jard. Bot. Buitenzorg, 1898, 2^{me} Suppl., pp. 136–42 (1 pl.).

§ S.B. k. k. Akad. Wiss. Wien, Dec. 1st, 1898. See Oesterr. Bot. Zeitschr., xlix. (1899) p. 74.

fore, to be not in the root, but in the axis of the inflorescence in *Cocos*, and in the upper part of the stem in *Arenga*.

In three woody plants, natives of Java * — *Conocephalus azureus* (Moraceæ), *Laportea crenulata* (Urticaceæ), and *Bambusa* sp.— Prof. Molisch finds an abundant bleeding from the stem, with very considerable pressure, up to two atmospheres, even at the time when the plant is in full leaf. The temperature during (our) winter months is very high, day and night, with a constantly cloudy sky and daily rains.

From incisions in the stem of climbing plants † he finds a copious flow of sap, both in the Tropics and in European species. The sap flows from the vessels, thus explaining their unusual size in climbing plants. The flow is a purely physical result of the exposure of the vessels on both sides, and shows that capillarity cannot play the part either of a water-retaining or of a water-raising force to any considerable extent. The phenomenon takes place, in *Vitis* and *Clematis*, in the height of summer, even in very dry weather and intense heat.

Modification of Respiration by Changes in Temperature.‡—M. W. Palladine states that (in *Vicia Faba*), if shoots are first of all placed either in a very high or a very low temperature, and then transferred to air of an ordinary temperature, the intensity of respiration is then greatly increased as compared with that of shoots not previously so exposed. The excess amounted to as much as 40–53 per cent.

(3) Irritability.

Motile Organs of Leaf-stalks.§—Herr M. Moebius describes these structures especially in *Robinia*, *Rhus*, and *Akebia*, which he takes as three characteristic types. In *Robinia* there is in the leaf-stalk a circle of distinct vascular bundles held together only by an outer ring of bast-fibres, with a broad pith and narrow cortex; while in the cushion there is a very broad cortex and a closed xylem and phloem-cylinder, surrounded by a collenchyme ring round a narrow pith. In the cushions of *Rhus* and *Akebia* the vascular bundles are distinct, while in *Robinia* they are united; in the two former genera the pith is more developed in the cushion than in the leaf-stalk; in *Robinia* much less developed. *Virgilia lutea* and *Platanus orientalis* have hollow cushions. Stomates are hardly ever found on the cushions. The aquiferous tissue in the cushions of the Marantaceæ has a function in connection with their curvature.

Rapidity of Circumnutation.‖—Elizabeth A. Simons finds the circumnutation, in the plants examined, to be in most cases considerably more rapid than that stated by Darwin, and the optimum temperature to be as much as 12° higher, about 28° C. On dull cold days with a temperature of 15°–19°, the movements were found to be extremely slow. In *Convolvulus sepium*, two distinct types of stem were observed,— a rapidly circumnutating one, and a prostrate one showing extremely feeble movements.

* Ann. Jard. Bot. Buitenzorg, 1898, 2me Suppl., pp. 23–32.

† S.B. k. k. Akad. Wiss. Wien, cvii. (1898) 18 pp. See Bot. Ztg., xlvii. (1899) 2te Abth., p. 132.

‡ Comptes Rendus, cxxviii. (1899) pp. 1410–1.

§ 'Ueb. Bewegungsorgane an Blattstielen,' 1899 (1 pl.). See Bot. Centralbl., lxxviii. (1899) p. 342.

‖ Contrib. from the Bot. Laboratory, Univ. of Pennsylvania, ii. (1898) pp. 66–79.

Thermotropic Movement of the Leaves of Rhododendron maximum.*—Dr. J. W. Harshberger describes the movements of the leaves of this evergreen shrub, which can be followed out in cut branches stuck into the soil in pots. Under a low temperature the petiole takes a sharp bend downwards through an angle of about 70°; the lower side of the petiole is puckered into transverse folds, and the leaves are rolled tightly inwards in a convolute manner, so that the upper epiderm only is exposed. They are thus protected against excessive transpiration, and snow and ice are readily thrown off. The author attributes the movements to the gradual passage of sap through the contractile protoplasmic sac of each cell into the intercellular spaces, or to the movement of the liquid from cell to cell by means of the protoplasmic bridges.

(4) Chemical Changes (including Respiration and Fermentation).

Decomposition and Formation of Albumen in Plants.†—From experiments on *Pisum sativum*, *Vicia Faba*, and *Lupinus luteus*, M. N. Prianischnikow derives the following general conclusions. The process of decomposition of albumen has a "great period," and is characterised by a "great curve" of its own. The process of accumulation of asparagin has also a great curve; and the maxima of the two curves coincide nearly or completely. These two curves attain their maxima some days earlier than that which expresses the elimination of carbon dioxide. At the close of the period of germination, the energy of the accumulation of asparagin—or rather the accumulation of the nitrogen of asparagin—exceeds the rapidity of the passage of the nitrogen of albumen into the form of other combinations.

Production of Alcohol in Plants.—From observations made on wheat and hazel, M. Berthelot ‡ finds that, under normal conditions of respiration and assimilation, minute quantities of alcohol are produced in the tissues of plants, probably formed from the decomposition of carbohydrates, in a similar way to that in which methyl-alcohol is sometimes produced.

M. P. Mazé § corroborates these results, and believes that the alcohol is formed in the living cells at the expense of the glucoses by a normal diastatic process.

Diastatic Function of Indigoferous Plants.‖—From experiments made on *Isatis alpina*, M. L. Bréaudat concludes that, in those species of *Indigofera* and *Isatis* which yield indigo, the presence of alkaline bases or those of the alkaline earths, or their soluble or insoluble carbonates, is necessary for the formation of indigo; while that of acids or neutral salts inhibits it. The oxidising power of the soluble oxydase contained in the sap is but very feeble; but this power is increased by the presence of alkalies and alkaline carbonates.

Nitrification of Organic Nitrogen.¶—Herr W. Omelianski states with simple directness that the work of Frankland, Warrington,

* Proc. Acad. Nat. Sci. Philadelphia, 1899, pp. 219–24 (3 figs.).
† Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 151–5.
‡ Comptes Rendus, cxxviii. (1899) pp. 1366–70. § Tom. cit., pp. 1608–10.
‖ Tom. cit., pp. 1478–80. Cf. this Journal, *ante*, p. 181.
¶ Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 473–90.

Stutzer, and others, which does not agree with his own, is based on errors of observation. According to the author, the nitrification of organic nitrogen is not perfected by pure cultures of nitrification bacteria. These organisms have absolutely no power of attacking nitrogenous organic substances, either by splitting off ammonia or by immediate oxidation of the organic nitrogen. For the nitrification of organic nitrogen it is indispensable that it should first be mineralised, that is to say, converted into ammonia, and for this the co-operation of at least one micro-organism is requisite by which organic substances are decomposed with the formation of ammonia.

Fermentation of Barbary Figs.* — M. E. Rolants states that the Barbary fig (*Cactus Opuntia*) may be advantageously employed for the industrial manufacture of alcohol. The yield of alcohol at 100° was found to be from 40–60 litres per 1000 kilos of fruit, according to the richness of the fruit in fermentable sugar. The yeasts used were six in number, those yielding the best returns being a Logos yeast and a champagne-wine ferment.

Curing and Fermentation of Cigar-leaf Tobacco.† —According to Dr. O. Loew, the so-called tobacco fermentation is not caused by bacteria, the principal changes that take place during the curing and fermenting of tobacco being due to the action of soluble ferments or enzymes. In the curing process four enzymes co-operate—an amylolytic and proteolytic, and two oxidising, while in the fermenting process the main changes are due to oxidising enzymes, and consist in the oxidation of nicotine and other compounds.

In green tobacco two oxidising enzymes may exist, an oxydase and a peroxydase. The development of colour and aroma is principally due to the action of the oxidising enzymes.

γ. General.

Terminology of Spores.‡—M. P. van Tieghem proposes to limit the term spore to those cells which are formed on an adult plant, and which develop into a new adult individual. All the Fungi and most Algæ form spores; the propagules of the Bryophyta are spores; but no vascular plants form spores. The term *diode* is suggested for reproductive bodies arising on the adult which develop into a rudimentary body; the prothallium thus establishing a transition between the adult and the rudimentary stages. Thallophytes and Bryophytes have no diodes; they belong only to vascular plants, which may hence be termed *Diodophytes* or *Prothallaceæ*. Diodes may be all alike (*isodiodes*), or they may be differentiated (*heterodiodes*) into *microdiodes* and *macrodiodes*. They are usually formed in groups surrounded by one or more layers of sterile cells, forming a *diodange*.

All the Bryophyta, the Florideæ, and the Mucorini, produce cells which are not spores, because they do not arise on the adult stage, nor diodes, because they produce directly the adult form; for these van Tieghem proposes the term *tomie*, and the rudimentary structure on

* Ann. Inst. Pasteur, xiii. (1899) pp. 452–5.
† U.S. Dept. of Agriculture, Rep. No. 59, 1899, 34 pp.
‡ Journ. de Bot. (Morot), xiii. (1899) pp. 137–42.

which they are formed a *tomiogone*; they may be contained in *tomianges*. They are not found in vascular plants.

In Phanerogams the pollen-grains are microdiodes, the pollen-sacs microdiodanges; the nucellus of the ovule is a macrodiodange in which the macrodiode stage is suppressed; the endosperm is the female prothallium. In the Muscineæ the so-called spores, sporange, and sporogone are respectively tomies, tomiange, and tomiogone, while the propagules are the true spores. In the Florideæ the tetraspores are true spores, while the carpospores are tomies, and the cystocarp a tomiogone.

Myrmecophilous Plants.*—Herr F. Ludwig gives an enumeration of the plants whose seeds are largely disseminated through the agency of ants. Among them are *Pulmonaria officinalis*, *Viola odorata* (fl. alb.), and *Chelidonium majus*.

Inheritance of Variation in the Corolla of Veronica Buxbaumii.†—Mr. W. Bateson and Miss D. F. M. Pertz thus sum up the results of a series of observations on this subject. There was no indication that families of plants raised from capsules formed by self-fertilisation of abnormal flowers in general showed either greater variability or greater percentage of any one abnormal form than families similarly raised from normal flowers on the same plant. On the contrary, the evidence tends to show that the self-fertilised offspring of normal and abnormal flowers on the whole conform to an equal degree with the general characteristics of the parent plant, or more strictly, of the strain or race to which the parent belonged.

B. CRYPTOGAMIA.

Muscineæ.

Dehiscence of the Antherid in Muscineæ.‡—Prof. K. Goebel describes the mechanism for the dehiscence of the antherid in several typical genera of Musci and Hepaticæ. In both families the wall of the antherid takes part in the process. This is effected by the separation of a strongly intumescent mucilage in its cells, which, from its increase in bulk from the absorption of water, causes the opening of the antherid. In the Musci, but not in the Hepaticæ, there is an additional development in the shape of a definitely localised dehiscence-cap, the function of which calls to mind the annulus of the spore-capsule.

Sporophyte of Funaria and Mnium.§—According to Prof. R. H. True the calyptra is in these genera of Moss a protective structure, chiefly useful in preventing desiccation. After the calyptra breaks loose from the gametophyte, growth is confined to the distal end of the sporophyte, and the growing region, about 2 mm. long, is entirely included by the calyptra. In *Funaria* the cells of the calyptra contain chlorophyll. The curvature of the seta results as a response to the stimulus of gravitation. The direction of the strongest illumination usually determines the radius in which the capsule shall fall.

* Illust. Zeitschr. f. Entomologie, iv. pp. 38–41. See Bot. Centralbl., lxxviii. (1899) p. 370. † Proc. Cambridge Phil. Soc., x. (1899) pp. 78–92 (1 pl.).
‡ Ann. Jard. Bot. Buitenzorg, 1898, 2me Suppl., pp. 65–72.
§ Proc. Amer. Ass. Adv. Sci., xlvii. (1898) p. 435.

Leaf of Fissidens.*—From the nerve-structure of the leaf of *Fissidens*, Mr. E. S. Salmon argues in favour of Robt. Brown's explanation of the peculiar form of the leaf, viz. that the sheathing part alone is the true leaf, all the rest—usually called the superior and the inferior laminæ—being an outgrowth from the back of the leaf, in which a nerve has been developed. The author accepts Mitten's classification, placing the genera *Fissidens*, *Bryoxiphium*, *Sorapilla*, and *Eustichia* together in the tribe Skitophylleæ.

Sporogone of Hepaticæ.†—Herr J. Andreas gives an exhaustive account of the structure of the wall of the sporogone and the mode of dehiscence in the Marchantieæ and the Jungermanniaceæ. In these two families, in which the capsule must be regarded as a typical sporogone, it remains (except in the Operculatæ) until ripe enclosed by the archegone as a calyptra, which it only breaks through when ripe by the elongation of the stalk, the spores then escaping immediately. In the Operculatæ the sporogone breaks through the calyptra before it is ripe. The sporogone varies greatly in size and form, as well as in thickness, and in the number of layers of which it is composed. It is distinguished by the almost universal thickenings in its epidermal cells. The mode of dehiscence also varies greatly. On these various points three types may be distinguished, viz.:—

1. *The Marchantieæ.* The wall of the capsule is always composed of a single layer of cells, except at the apex. Three different modes of dehiscence are described in detail:—(1) in *Lunularia* and *Cyathodium*; (2) in *Fegatella* and *Dumortiera*; (3) in *Duvalia* and *Grimaldia*. As regards the structure of the wall, the genera are arranged under four different types, which are described in detail in a number of species.

2. *The anacrogynous Jungermanniaceæ.* The structure of the wall of the sporogone varies very greatly in many different directions. It may be composed of a single or of many layers of cells. Seven of the species examined, belonging to four genera, have elaterophores.

3. *The acrogynous Jungermanniaceæ.* The structure of the wall of the sporogone displays much greater uniformity; it is always composed of several (2–8) layers of cells. The variations refer to the number of layers and to the development of the thickenings in the layer which bounds the spore-cavity. The author classes the genera under four types,—those of *Jungermannia*, *Fegatella*, *Symphyogyna*, and the Operculatæ.

Cleveideæ.‡—Graf zu Solms-Laubach discusses at length the relationship to one another of the three genera of this family of Marchantiaceæ, *Clevea*, *Peltolepis*, and *Sauteria*, and their geographical distribution.

Wettsteinia, a new genus of Hepaticæ.§ — Dr. V. Schiffner identifies van der Sande Lacoste's two Indo-Malayan species of *Plagiochila*, *P. inversa* and *scabra*, but constitutes them, under the name *Wettsteinia inversa*, the type of a new genus, distinguished from *Plagiochila* by

* Ann. of Bot., xiii. (1899) pp. 103–30 (3 pls.).
† Flora, lxxxvi. (1899) pp. 162–213 (1 pl. and 29 figs.).
‡ Bot. Ztg., lvii. (1899) 1[te] Abth., pp. 15–37.
§ Ann. Jard. Bot. Buitenzorg, 1898, 2[me] Suppl. pp. 39–46.

the leaf-insertion and the incurved dorsal margin of the leaves. It is nearly related to *Adelanthus* and *Marsupidium.*

Algæ.

Cicatrisation and Prolification in Marine Algæ.*—Herr E. Küster describes the methods by which injured cells and tissues are regenerated in sea-weeds. Cicatrisation-membranes in injured cells are almost confined to the Siphoneæ, especially to *Anadyomene* (*stellata*) and *Halimeda.* Cicatrisation-tissues are much more widely distributed. In *Fucus* and *Halidrys* they assume the form of tuberous outgrowths. Prolification after injury occurs commonly in the Phæophyceæ and Florideæ, and is found also in the Siphoneæ and Fucaceæ; it is especially common in the Squamariaceæ. In most cases the adventitious shoots spring from the mid-rib which contains the conducting elements. In many of the more highly organised Fucaceæ it is only the long shoots which are capable of prolification. *Fucus*, *Pelvetia*, and *Gelidium* display especial capacity in this direction. *Padina pavonia* is characterised by its capability for vegetative multiplication.

Coating of Algæ on Plants in Greenhouses.† — Herr A. Maurizio enumerates the Algæ (including Schizophyceæ) which are most commonly found on cultivated plants, chiefly in greenhouses and hothouses. There are no special species characterised by this habit, and the conditions which favour their appearance and disappearance are involved in much obscurity. The injurious effects on the host-plant arise chiefly from the deprivation of light and the hindrance to transpiration.

Chantransia endozoica sp. n.‡ — Mr. O. V. Darbishire records the first example of a *Chantransia* parasitic on an animal organism, viz. on *Alcyonidium gelatinosum* off the south of Ireland, imparting a red colour to the host. It is characterised by the absence of hyaline hair-structures, and of a distinctly differentiated basal organ. It develops both on the outer wall and in the interior of the host.

Harveyella mirabilis. §—Mr. H. H. Sturch has found this parasitic alga growing abundantly on *Rhodomela subfusca*, forming small hemispherical cushions. The thallus, when mature, consists of three parts,—much-branched filaments growing in the interior of the host, which absorb nourishment from the contents of the cells of the host, and a hemispherical external portion, composed of a small-celled peripheral layer and a larger-celled central mass. The antherids are developed over the whole surface of the frond, the trichogynes from growing peripheral cells. The carpogonial branch invariably consists of three small cells, upon which is seated the carpogone with its trichogyne. The peripheral cell to which the carpogonial branch is attached is the auxiliary cell. When the trichogyne is ready for impregnation, it projects considerably beyond the surface of the plant, and is covered by a thick gelatinous sheath. By fusion of the auxiliary cell with the cells of two small sterile filaments, a large cell is produced, which is soon divided into an upper smaller hemispherical cell and a lower larger

* Flora, lxxxvi. (1899) pp. 143–60 (6 figs). † Tom. cit., pp. 113–42 (1 pl.).
‡ Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 13–7 (1 pl.).
§ Ann. of Bot., xiii. (1899) pp. 83–102 (2 pls.).

irregularly shaped cell. The upper cell divides rapidly, and gives rise to the young gonimoblast, which branches copiously and horizontally in all directions among the cells of the thallus. The spores are developed from terminal cells of erect gonimoblast filaments, these filaments extending round the whole hemispherical external frond. The tetrasporanges are formed from one of the ordinary distal cells of a peripheral layer.

The author proposes to erect the genus into a distinct family of the Gigartinaceæ, Harveyelleæ, distinguished by the gonimoblast branching freely among the thallus cells beneath the peripheral layer.

Fertilisation of Sphæroplea.*—Herr H. Klebahn regards the two varieties of *Sphæroplea annulina*, vars. Braunii and crassisepta, as constituting distinct species; they differ in the width of the vegetative cells and the size of the oospheres; in the nature of the septa; in the number of nuclei and pyrenoids in the rings of the vegetative cells; in the divisions of the antherids and oospheres; in the changes of the rings in the antherids; and in the mode of breaking up of the protoplasm, and the position of the oosphere in the oogone. The following are the most important results of a fresh investigation of the mode of impregnation.

Cell-division takes place karyokinetically. The nuclei of the antherozoids result from repeated karyokinesis of the nucleus of the antherid; the nuclei of the oospheres are derived from those of the oogone without apparent change. The oospheres of the variety Braunii usually contain more than one nucleus, both before and after impregnation; even in the ripe oosperm there appears to be more than one. The oospheres of the variety crassisepta, on the other hand, contain only one nucleus. The impregnation of the oosphere, even when it contains several nuclei, is effected by a single antherozoid. In S. Braunii the nucleus of the antherozoid fuses with one of the nuclei of the oosphere, which is indistinguishable beforehand from the other nuclei.

Fucus Hybrids.†—Mr. J. Ll. Williams has obtained a new hybrid in the Fucaceæ,—between *Ascophyllum nodosum* ♂ and *Fucus vesiculosus* ♀. No corresponding impregnation could be obtained between *F. vesiculosus* ♂ and *A. nodosum* ♀.

Sexuality of the Tilopterideæ.‡—M. C. Sauvageau gives more detailed reasons for withdrawing *Ectocarpus pusillus* from that genus, and placing it in the new genus *Acinetospora*, which, together with *Haplospora* and *Tilopteris*, makes up the Tilopterideæ. The so-called "monospores" display the usual characteristic of vegetative organs of propagation in their very great variability in size; they germinate with remarkable facility. *Ectocarpus crinitus* must probably be transferred to this family along with *E. pusillus*. The Tilopterideæ may be defined as Phæosporeæ with endogenous propagules. *Acinetospora* is monosiphonous; *Tilopteris* and *Haplospora* are polysiphonous, at least at their base.

Auxospores of Diatoms.§—Herr G. Karsten distinguishes four types in the mode of formation of the auxospores of diatoms:—In the first type only a single mother-cell takes part in the formation of the auxo-

* 'Die Befruchtung v. *Sphæroplea annulina*,' 1899 (1 pl.). See Bot. Centralbl., lxxviii. (1899) p. 362.

† Ann. of Bot., xiii. (1899) pp. 187–8.

‡ Journ. de Bot. (Morot), xiii. (1899) pp. 107–27 (5 figs.). Cf. this Journal, 1898, p. 566.

§ Ann. Jard. Bot. Buitenzorg, 1898, 2me Suppl., pp. 47–51.

spore, and the process must, therefore, be regarded as only imperfectly sexual. It occurs in many species of *Synedra*, in *Rhabdonema arcuatum*, and in *Achnanthes subsessilis*. In the second type two auxospores are formed from four daughter-cells resulting from two mother-cells. It has been observed in many species, and is the prevailing one in the "pennate diatoms." A further advance in sexual character is exhibited by the third type, where one auxospore is formed directly by the union of two mother-cells; it has been noted in species of *Cocconeis*, *Eunotia*, *Cymatopleura*, *Surirella*, and *Auricula*. The fourth type, a purely non-sexual one, where one auxospore results from a single mother-cell, appears to be the sole one in the group of "centric diatoms," e.g. *Melosira* and many others.

Derbesia and Bryopsis.* — Herr E. Küster has investigated the nature of the spherical colourless bodies which are expelled with considerable force when a living tube of *Derbesia Lamourouxii* is wounded. They are very numerous—from 50 to 200 from a single tube—and vary greatly in size; the author finds them to possess all the properties of true sphero-crystals. Similar results were obtained with *Bryopsis*, but not with any other of the genera of Siphoneæ. The protoplasm of a *Bryopsis*-tube, when injured, is transformed partly into doubly refractive sphero-crystals, partly into a solid amorphous substance.

Herr Küster believes this to be the only recorded example of the formation of sphero-crystals as the result of a disorganisation of protoplasm.

Fungi.

Fungi which attack Timber.† — Herr F. Czapek confirms the observations of Miyoshi ‡ and Marshall Ward,§ that the hyphæ of certain fungi have the power not only of perforating wood, but of consuming the stores of starch and other food-material. He succeeded, in the cases of *Pleurotus pulmonarius* and *Merulius lachrymans*, in extracting the enzyme by means of which the lignified walls of the cells are destroyed, and proposes for it the term *hadromase*, in contradistinction to the cytase which consumes the cellulose.

Biology and Cytology of Achlya.‖—Mr. A. H. Trow finds, on flies, a species of *Achlya* which he regards as a variety of the American species *americana*. A study of its life-history has led to the following general conclusions.

The nucleus is bounded by a nuclear membrane, and possesses a central body of spongy texture, which contains chromatin and nucleolar matter, but is neither nucleole nor chromosome. The space between the nuclear membrane and the central body is occupied by nucleo-hyaloplasm, and is traversed by fine threads of linin. The nucleus undergoes divisions in the mycele, and the nuclei produced in this way pass into the sporanges and gametanges. Neither nuclear divisions nor fusions take place in the sporange, nor any nuclear fusion in the gametange.

* Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 77–84 (1 pl.).
† Tom. cit., pp. 166–70.
‡ Cf. this Journal, 1896, p. 92.
§ Cf. this Journal, 1898, p. 660.
‖ Ann. of Bot., xiii. (1899) pp. 131–79 (3 pls.). Cf. this Journal, 1896, p. 216.

In the oogones and antherids many at least of the nuclei undergo division by a typical indirect mode, the number of chromosomes being probably four. The author believes that a true process of fertilisation takes place; the entrance of the male nucleus into the ovum-cell takes place when both gameto-nuclei are in the stage of anaphasis. The single nucleus of the "oospore" undergoes indirect division, and the number of chromosomes which appear during these divisions seems to be eight.

The author draws the general conclusion that the reducing divisions in the different groups of plants are not all homologous; in Thallophytes there are apparently two types which are not homologous.

New Genera of Fungi.—Herr W. Tranzschel* describes two new genera of Ascomycetes from Russia, viz.:—

Dasyscyphella (Pezizineæ). Apotheces hairy; paraphyses filiform; spores filiform, 2–several-celled.

Helminthascus (Pyrenomycetes). Stroma disc-shaped, flat, brightly coloured, developed on Vertebrata; the body of the animal, penetrated by the mycele, forms a hypostroma, on which the true stroma is placed; peritheces completely imbedded in the stroma, without a distinct receptacle; asci cylindrical, elongated, 8-spored; spores filiform, as long as the asci, septated, breaking up into separate joints. Most nearly allied to *Cordiceps.*

M. Raciborski † makes a parasitic fungus found by him in Java on *Psophocarpus tetragonolobus*, the type of a new genus of Chytridiaceæ, *Woroninella.*

A new genus of Ascomycetes from Brazil, *Xylariodiscus*, is described by Herr P. Hennings ‡:—Stroma erectum, longe stipitatum, parte superiori disciforme v. cupulatum, carbonaceum; perithecia superficialia, semi-immersa, subconoidea, atra, carbonacea, papillata; asci cylindraceo-clavati, octospori, paraphysati; sporæ oblonge naviculariеæ, continuæ, atræ.

From Java, M. N. Patouillard § describes two new genera of Hyphomycetes, with the following diagnoses.

Ceratocladium. Stroma erectum, dendroides, ramosum, induratum, ex hyphis filiformibus transverse septatis simplicibus v. ramosis coalitis compositum; hyphæ periphericæ fertiles, aspergilliformes, apice inflatæ; basidia globoso-ovoidea, dense congesta; conidia hyalina v. pallide colorata, simplicia, non catenulata.

Macrostilbum. Terrestre, magnum. Stroma verticale, carnosum, apice breviter ramulosum; conidia apicalia, capitulata, ovoidea, continua.

Modification of Characters in the Uredineæ.‖—Herr P. Magnus adduces a number of instances in which particular species or subgenera deviate from the typical characters of the genus in the structure of the teleutospores, especially in the number and form of the cells of which they are composed, and in the number of germinating pores; and points

* Hedwigia, xxxviii. (1899) Beibl., pp. 10–12.
† Zeitschr. f. Pflanzenkrankheiten, viii. (1898) pp. 195–200. See Hedwigia, xxxviii. (1899) Beibl., p. 33.
‡ Hedwigia, xxxviii. (1899) Beibl., pp. 63–4 (1 fig.).
§ Bull. Soc. Mycol. France, xiv. (1898) pp. 182–98. See Bot. Centralbl., 1899, Beih., p. 404. ‖ Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 178–84 (1 pl.).

out the connection between these deviations and corresponding biological variations.

Uropyxis.*—Herr P. Magnus maintains the independence of this genus of Uredineæ, as distinct from *Puccinia*, although the bicellular structure of the teleutospores does not always hold good. He divides the genus into two sections; the first with 3-celled teleutospores, comprising only *U. deglubens*, parasitic on Leguminosæ in North America; the other with 2-celled teleutospores, including all the remaining species, found on Leguminosæ, on *Berberis*, and on *Fraxinus*.

Phyllactinia.†—Herr E. Palla describes a new species of this genus of Uredineæ, *P. Berberidis* sp. n., parasitic on the leaves of the barberry; and adds some details as to the mode of parasitism in the genus. The hyphæ which develop on the epiderm of the host-plant do not perforate the epidermal cells, but put out lateral hyphæ through the stomates into the intercellular system of the spongy parenchyme, and it is only these intercellular hyphæ which form haustoria. He proposes the division of the Erysiphaceæ into two groups, the Erysipheæ and the Phyllactinieæ. In the former the mycele grows only superficially on the host-plant, and the haustoria penetrate the epidermal cells; several conids are abstricted in succession from the conidiophore, and the ascospores are usually colourless. The latter group, consisting at present only of the genus *Phyllactinium*, is characterised by the development of an intercellular mycele; the conidiophore produces only a single conid; and the ascus and ascospores are coloured by yellow drops of oil.

Parasitic Fungi.—Herr T. Ritzema Bos ‡ gives a full account of a disease of the peony caused by *Botrytis Pæoniæ*; also of one of the lily of the valley caused by an apparently identical species.

Herren F. Wagner and P. Sorauer § have investigated a disease of lupins which they attribute to a parasitic fungus *Pestalozzia Lupini* sp. n. The species chiefly attacked are *Lupinus Cruikshanksii* and *L. mutabilis*.

Mr. G. E. Stone and Mr. R. E. Smith ‖ give a full description of the life-history of the asparagus-rust, *Puccinia Asparagi*, which has been very injurious to the cultivation of asparagus in the United States.

Prof. G. Lagerheim ¶ describes a new disease of the lucerne caused in Ecuador by the attacks of a fungus belonging to the Chytridiaceæ, identical with *Urophlyctis pulposa* which attacks *Chenopodium glaucum*; also a new species of *Empusa*, *E. phalangicida*, parasitic on spiders; and *Iola Lasioboli* sp. n., on *Lasiobolus equinus*, the two latter in Sweden.

Massee's Text-book of Plant Diseases.**—In his Text-book of Plant Diseases caused by Cryptogamic Parasites, Mr. G. Massee first

* Ber. Deutsch. Bot. Gesell., xvii. (1899) pp. 112–20 (2 figs.).
† Tom. cit., pp. 64–72 (1 pl.).
‡ Zeitschr. f. Pflanzenkrankheiten, viii. (1898) p. 263. See Bot. Centralbl., lxxviii. (1899) p. 89.
§ Tom. cit., p. 266 (1 pl.). See Bot. Centralbl., lxxviii. (1899) p. 377.
‖ Mass. Agric. Coll. Bulletin, No. 61, 1899, 20 pp. and 2 pls.
¶ Bih. k. Svensk. Vet.-Akad. Handl., xxiv. (1898) Afd. 3, 21 pp. (3 pls. and 2 figs.).
** London, 1899, xii. and 458 pp. and 92 figs.

gives a general account of the structure and mode of propagation of Fungi, followed by a chapter on the mode of combating the diseases caused by them. Then succeeds a description of each separate parasite, taking the various families of Fungi in succession, followed by the Myxomycetes and the Schizomycetes. Under each species reference is made to its already existing literature; and a feature of the book is that the brief technical descriptions are reserved for a special chapter, and are kept separate from the general account of the life-history of the parasite, the nature of the disease caused by it, and the most efficient remedies.

Fungi Parasitic on Lichens.*—In a further instalment of his paper on this subject, Herr W. Zopf describes the following new species:—*Echinothecium reticulatum* g. et sp. n., *Microthyrium maculans*, *Lichenosticta podetiicola*, *Pharcidia Arnoldiana*, *Phæospora Catolechiæ*, and *Didymosphæria pulposa*. The diagnosis of the new genus *Echinothecium*, belonging to the Sphæriaceæ, is thus given:—Lichenicolous; mycele superficial, composed of thick brown hyphæ which anastomose copiously and become torulose when old; peritheces arising as masses of tissue, provided with an ostiole and stiff simple hair-like appendages; asci swollen, sessile, 8-spored, ejaculatory; spores 2-celled, colourless, one cell longer than the other; paraphyses and periphyses wanting.

Spermogones of Lichens.†—Under the term spermogone Herr H. Glück includes all the conidial fructifications of lichens. He does not believe in the sexuality of the spermatia. He distinguishes four types of spermogones, according as they are entirely imbedded in the thallus, or lie in swellings of the thallus, or are partially imbedded, or entirely free. The structure of the spermogones is described in detail.

The sterigma of lichenologists, which is often multicellular and branched, is described as the conidial fructification (*Conidienstand*). The cell from which the spermatium is formed by abstriction or by the formation of a septum, is the sterigma; all the remaining (sterile) cells are basal cells.

Spermogones are classified under eight types, named from an important genus belonging to each type:—the *Peltigera*, the *Psora*, the *Cladonia*, the *Placodium*, the *Parmelia*, the *Sticta*, the *Physcia*, and the *Endocarpon* types. In the first two the spermatia are detached from the sterigma by the formation of a septum; while in all the others they are abstricted. In the third and fourth types the abstriction takes place from unicellular sterigmas; while in the remainder the sterigmas are only prolongations of basal cells. The last three types are distinguished by the relationship of the spermogones to the apotheces, by the contents of the spermogones, and by their physiological properties.

Cladonieæ.‡—In the third part of his Monograph of the Cladonieæ, Herr E. Wainio discusses their general structure; the following being some of the more important points that are brought out.

* Nova Acta k. Leopold-Carol. Akad., lxx. (1898) pp. 241–88 (44 figs.). Cf. this Journal, 1897, p. 565.

† Verhandl. naturhist. Ver. Heidelberg, vi. (1899) pp. 81–216 (2 pls. and 50 figs.). See Bot. Centralbl., lxxviii. (1899) p. 275.

‡ Acta Soc. p. fauna et flora Fennica, xiv. (1897) 268 pp. See Bot. Centralbl., lxxviii. (1899) p. 207.

From the germinating spore, after the formation of the first stroma, a secondary development of the hypothallus takes place. This may take the form either of irregular unbranched hyphæ, or of branched rhizines which are associated with the medullary layer of the thallus. The primary thallus consists, in *Cenomyce*, to which the greater number of the cup-lichens belong, of scales or leaflets; rarely, as in *Pycnothelia* and *Cladina*, is it crustaceous. The crustaceous thallus has the same anatomical structure as the scales, except that no true cortical layer can be distinguished in it. The foliaceous thallus has three layers, cortex, gonidial zone, and medulla. The soredes originate in the gonidial zone at the margin of the thallus-scales. Above the primary thallus are the fruticose podetia. Wainio now regards the apotheces as belonging to the fructification, and as elongations of the conceptacle. The podetia of many Cladonieæ expand laterally into the cups or scyphi. In all the Cladonieæ the gonidial apparatus or spermogones originate from the podetia.

The author then discusses the phylogenetic development of the Cladonieæ, and the relationship to one another of the genera and species.

Structure of Gyrophora.*—Herr G. Lindau describes the mode of formation of the "trichogyne" in this genus, which resembles that in other foliaceous lichens. Since it has no homology with the trichogyne of the Florideæ, the author proposes to substitute for it the term *terebrator*. Its function appears to be to break through the hard cortex which lies above the primordium of the apothece, and gradually to disorganise it. Lindau further proposes to abandon the term "pseudo-parenchyme" for a tissue composed of interwoven hyphæ, and to substitute *plectenchyme*, which may then be either a *paraplectenchyme* or a *prosoplectenchyme*. *Gyrophora* exhibits a remarkable development of marginal growth, the thallus forming a large number of fine lobes, which afterwards unite in growth to form the continuous thallus; frequently, however, leaving holes in the middle.

Ropiness of Must and Wine.†—Herr R. Meissner describes some yeasts which were isolated from the mucoid flux of a plane-tree and from three ropy wines. As culture media, pasteurised grape-must, Sicilian must, 10 per cent. grape-must gelatin, and artificial solutions were used.

The structure and development of mucous yeasts are simple, and resemble those of true yeasts. They are about half the size of the latter. In some, glycogen could be demonstrated. Spore-formation was not observed. Some formed a certain amount of surface scum or even a membrane.

Instead of forming alcohol in the nutrient fluid or in wine or must, the mucous yeast produced a ropy viscid substance. For their growth they are in urgent need of oxygen. Carbonic acid hinders their development, but does not kill them. Nine per cent. of alcohol prevents development; but on transference to sweet must they revive.

* Beitr. z. Kenntn. d. Gattung Gyrophora, 1899 (1 pl.). See Bot. Centralbl., lxxviii. (1899) p. 337.

† Landwirthsch. Jahrb., 1898, pp. 716–72 (2 pls.). See Bot. Centralbl., lxxvii. (1899) pp. 375–7.

The nutrient substances are derived from ammonia and the must acids, and rapid growth takes place in ammonia. Sulphurous acid, tannin, and acetic acid inhibit the growth of these yeasts, and darkness is more favourable to their development than light.

The results from competition with different wine yeasts vary with the fermentive power; for if strong the wine yeasts prevail, and if weak the mucous yeasts gain the upper hand. The constitution of the wine was found to be a potent factor; for wines containing much alcohol and tannic acid were naturally resistant to the infection; while poor thin but sweet wines were easily liable to the affection.

Protection against ropiness is to be found in firing the casks, the use of pure strong yeasts, and the addition of tannic acid (4 grm. per hectolitre).

Saccharomyces septicus.*—Dr. L. De Gaetano describes a blastomycete which, when injected into the peritoneal sac of a guinea-pig, caused death within 12 hours from fibrinous peritonitis and general sepsis. *Saccharomyces septicus* grows best on the following media:—(1) Bouillon-potato infusion 1000 grm., Liebig's extract 20 grm., pepton 10 grm., grape-sugar 100 grm., tartaric acid 5–10 grm. (2) Agar-potato infusion 1000 grm., Liebig's extract 20 grm., pepton 10 grm., agar 2–3 per cent. The organism stains well with Gram and Weigert.

Vitality of Dried Yeast.†—Herr H. Will continues to test three samples of dried yeast kept for 12 years and 2 months. Though one sample had died owing to damage to the box in which it was kept, the other two samples were found to be still quite alive when tested on wort.

Spore-formation in Dematium pullulans.—Dr. F. Weleminsky ‡ claims to have observed the formation of endogenous spores in a specimen of *Dematium pullulans* de Bary. Two specimens were found together, and were cultivated on wort gelatin. Both grew not only in the ordinary way, producing resting cells and laterally sprouting conids, but also endogenous cells, i. e. spores, in the course of the same mycele. One of these original specimens lost the power of producing spores after one generation, while the other maintained the power. Several other culture-media were tried, the best results coming from simple wine-juice. Spore-formation was not observed on gypsum blocks; spores were reproduced from cultures which had been allowed to dry for three weeks. The author is of opinion that *D. pullulans* should be classed with the Ascomycetes, and near to *Saccharomyces* and *Exoascus*.

Herren A. Klöcker and H. Schiönning § are of opinion that the bodies described by Weleminsky as spores are really conids, the result of ingrowth from an adjacent mycele. The complete details are promised later.

Systematic Position of Trichophyton.‖—MM. L. Matruchot and Ch. Dassonville express the opinion that *Trichophyton* should be placed in the natural family of Gymnoasci. The genus to which it bears most similarity is *Ctenomyces*. The general grounds on which they base this

* Riforma Med., 1897, No. 200. See Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) p. 833.

† Zeitschr. f. d. gesammte Brauwesen, 1899, p. 43. See Centralbl. Bakt. u. Par., 2te Abt., v. (1899) p. 527.

‡ Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 297–303 (9 figs.).

§ Tom. cit., pp. 505–7. ‖ Comptes Rendus, cxxviii. (1899) pp. 1411–3.

opinion are derived from the characters and the development of the cultural fructiferous forms of *Trichophyton*. These are supported by similarity of substrata, by production of yellow or red pigment, by the presence of spiral forms, and (in *Ctenomyces*) by spindle-shaped and multicellular segments, like those so frequent in *Trichophyton*. In the same family the authors are also inclined to include *Achorion* and indeed many other pathogenic fungi.

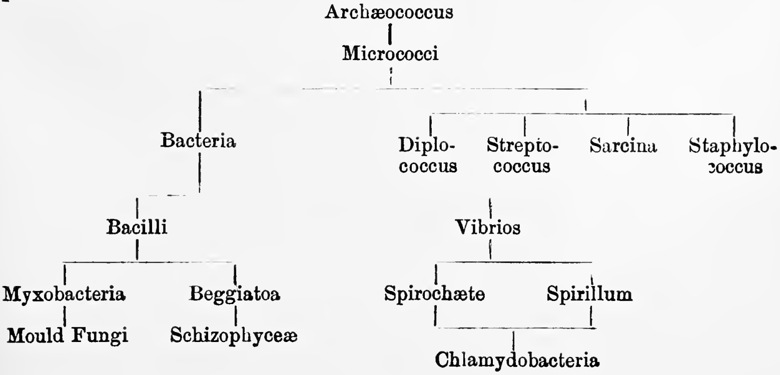
Sporothrix Fungus in Abscess.*—Dr. B. R. Schenck records a case of refractory abscess of the skin associated with lymphatic infection, due to the presence of a fungus related to the *Sporotricha*. The organism was isolated thrice from lesions in the arm, two of them being pure cultures. Cultures were easily obtained on all the usual media. The organism was found to be strictly aerobic, did not produce gas or coagulate milk; gelatin is slowly liquefied. Cover-glass preparations show a mycele and conids. The mycele is doubly contoured, and branches irregularly. The conids are elliptical or ovate and 3–5 μ in length. One illustration taken from a photograph shows a few mycelial threads and a large number of ovate spores scattered freely about and without any special distribution; other illustrations taken from camera drawings show mycele and germ-tubes, around the ends of which are collected small bunches of conids. The opinion of Dr. E. F. Smith, who reported on the growth appearances, &c., is that it is advisable to place the fungus among the *Sporotricha*.

Inoculation experiments made on animals gave positive local results on the dog, and positive general results (a sort of pyæmia) on mice. Guinea-pigs and rabbits were refractory.

Protophyta.

β. Schizomycetes.

Evolution of Bacteria.†—Dr. G. Catterina, after an exhaustive discussion of a critical and historical nature on the phylogenetic relations of bacteria, gives the following genealogical tree as representing the probable descent.



* Johns Hopkins Hosp. Bull., ix. (1898) pp. 286–90 (2 pls.).
† Bull. Soc. Veneto-Trentina di Sci. Nat., vi. (1899) pp. 155–205.

Microbes in the Arctic Regions.*—Dr. Levin, after a few remarks dealing with the exceptionally hygienic conditions of the Arctic regions, proceeds to a record of his own experiences. Air was taken from twenty different localities in the Arctic zone. In these samples only a few moulds were found. In 78 samples of sea-water, taken from the surface, bacteria were found in every case, but the numbers were very small; about one bacterium to each ccm. Eighty samples of water, taken from glaciers, snow, streams, ice, and melted snow, all gave evidence of the presence of bacteria, but the quantity was very small. Samples taken from deep-sea soundings showed a greater number of bacteria than on the surface. Three different kinds are mentioned, but minute particulars are not given.

The last series of experiments, or rather experiences, relate to observations made on the intestines and intestinal contents of animals inhabiting the Arctic regions, such as white bear, seal, shark, eider-duck, penguin, gull, guillemot, sea-urchin, anemone, shrimp, &c. In most cases the intestinal contents were found to be absolutely sterile. In one white bear and in two seals, a single species of bacterium, probably *Bacillus coli communis*, was detected. The rest of the Vertebrata were unaffected, but in the lower marine animals bacteria were almost invariably present.

The importance of these observations is certainly great, as they bear directly on the question whether bacteria are indispensable to nutrition. Several distinguished observers (Pasteur, Nencki, Nuttall, Thierfelder) have shown that digestion can be accomplished without the intervention of bacteria; while others † give good reasons for holding that bacteria are practically a most important factor in the digestive process.

Pigment-formation of Fluorescing Bacteria.‡—According to Herr K. Wolf, the green pigment of fluorescing bacteria is an accidental product, that is to say, it only occurs when the conditions of nutrition are extremely favourable to bacteria. They may thrive and develop well in many media, but without forming pigment. The production of pigment is of necessity associated with three factors, phosphoric acid salts, easily decomposable ammonia compounds, and free oxygen. If one of these three factors be absent, or even insufficient, pigment does not appear. *Bacillus fluorescens liquefaciens* and *B. pyocyaneus* thrive tolerably well, the bacteria which do not liquefy gelatin fare badly, when oxygen is excluded. All those that produce no ammonia produce no pigment. The brown hue of the cultures on boiled potato, on potato-gelatin, boiled white of egg, and in anaerobic cultures, does not depend on pigment formation but, as in the case of the bacteria of the *coli* group, is possibly to be explained by the arrangement of the micro-organisms. Fluorescing bacteria thrive on hen's egg under aerobic conditions. During the aerobic growth of fluorescing bacteria, oxygen is copiously absorbed and carbonic acid given off. Under similar conditions fluorescing bacteria produce a very considerable quantity of ammonia.

* Ann. Inst. Pasteur, xiii. (1899) pp. 558–67.

† Cf. this Journal, *ante*, p. 197.

‡ Dresden, 1897, 36 pp. See Bot. Centralbl., lxxviii. (1899) p. 133. Cf. this Journal, *ante*, p. 315.

Pyocyanin and its Mutations.*—According to Herr G. W. Boland, *B. pyocyaneus* forms only two pigments. One of these, formed also by many other bacteria, fluoresces. The second pigment, pyocyanin, owing to some oxidising action which takes place outside the medium, is converted into pyoxanthose; while, owing to certain at present unknown changes occurring within the medium, it passes into the red-brown pigment so frequently seen in old cultures.

Production of Amyloid Degeneration.†—Dr. E. Schepilewsky has produced amyloid degeneration in animals by injecting them with living bouillon and cartilage emulsion cultures of *Staph. pyogenes aureus*, by the injection of devitalised cultures of *Staph. pyogenes aureus*, and by the injection of ferments, e. g. rennet, pancreatin, and papayotin. The amyloid degeneration is, therefore, producible without the co-operation of living organisms or of bacterial products. It is most easily and certainly set up by injecting rabbits with large quantities of cultures of *Staph. py. aureus*, devitalised or attenuated by means of chloroform. The amyloid substance is also found in rabbits which have suffered from prolonged suppuration unconnected with bacteria. The appearance of true amyloid in the spleen, demonstrated by the characteristic reaction to anilin dyes, is preceded by a hyaline stage, which histologically closely resembles amyloid, but is distinguished therefrom by its reaction to the anilin pigments.

Reducing Action of Denitrifying Bacteria.‡—Sig. G. Ampola and Sig. C. Ulpiani point out that denitrifying bacteria do not attack asparagin or nitro-methane, and their action on ethylic nitrate is very slow. From this it is inferred that denitrification takes place only with oxygen compounds of nitrogen, and only with such of these as are electrolytes and are thus dissociated into ions in solution. Denitrifying bacteria are arranged under three heads:—(1) Those which destroy nitrites but not nitrates, e. g. *Bacterium denitrificans*; (2) those which destroy nitrates but not nitrites, e. g. *Bacillus pyocyaneus* and *Bacterium denitrificans* v.; (3) all other denitrifying bacteria which attack both nitrites and nitrates.

Examination of the action of *B. denitrificans* on metallic nitrates showed that the more electro-positive the metal, and the lower its atomic weight, the more rapidly does denitrification take place. The nitrates of certain alkaloids, brucine, strychnine, cocaine, pilocarpine, which are entirely ionised in solution, are soon denitrified.

Decomposition of Cement by Bacteria.§—According to Herren A. Stutzer and R. Hartleb, the loss of calcium by cement exposed to the prolonged action of potable water is not only due to the solvent property of carbonic acid, but also may depend to some extent on the action of bacteria. The brownish muddy residue of a cement which had lain long in water was washed with sterilised water, and then added to a solution of ammonium sulphate (1 grm. per litre). In six days nitrite was found to be present, and in fourteen days the ammonia had entirely

* Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 897-902.
† Tom. cit., pp. 849-62.
‡ Gazzetta, 1899, 29, i. pp. 49-72. See Journ. Chem. Soc., 1899, Abstr. ii. p. 444.
§ Zeit. angew. Chem., 1899, pp. 402-3. See Journ. Chem. Soc., 1899, Abstr. ii. p. 505.

disappeared. Asparagin is also converted into nitrite, but much more slowly, and sodium nitrite is gradually oxidised to nitrate through the agency of the microbes present in the cement.

Leucocytes and Immunity to Arsenious Acid.* — Dr. Besredka's third memoir deals with the part played by the leucocytes in the immunisation against soluble arsenious acid. The chief points are that rabbits may be immunised against fatal doses of arsenious acid by accustoming the leucocytes thereto. This may be done by spreading a fatal dose over the whole day, or by injecting a small dose previously, or by combining the two methods. The serum of animals immunised by any one of the foregoing methods possesses preventive and antitoxic properties against a dose of arsenious acid fatal within forty-eight hours. Antiarsenin is in all probability a non-arsenical compound.

The arsenic which is associated with the antiarsenin is not dialysable, and proceeds from the cells. The hypothesis of the neutralising action of antiarsenin, either partial or total, is in opposition to the facts. Antiarsenin acts upon the toxin through the intermediation of the leucocytes; suppression of the latter paralyses the action of the antiarsenin.

Phagocytosis in the Pigeon.†—M. Dembinski finds that there is a marked difference between the phagocytic reactions of the pigeon to human and to avian tubercle. His experiments show that the difference between avian and human tubercle bacilli can be detected directly after inoculation by the cell reaction which is excited. If the tubercle bacillus be avian, phagocytosis is powerless to arrest the development of the disease; for either the cells are unable to digest the englobed bacilli which thus preserve their vitality, or the number of bacilli incorporated may be very small. If the bacilli be human, they are at once blockaded and rendered harmless by the numerous leucocytes, by the agglomeration of which giant-cells are formed, and thus are produced phagocytic protectors of a more powerful order than isolated leucocytes.

Mechanism of Agglutination.‡ — According to Dr. J. Bordet, the theories which would explain microbic agglutination by swelling and viscosity of membranes or cilia, conflict with numerous objections, and do not explain all the phenomena of agglutination. On similar grounds, the theory that regards agglutination as being due to the formation of a precipitate in the liquid may also be discarded. Now agglutination may affect very different elements (globules, casein, microbes); and for agglutination by serums only one explanation is admissible. It may be accepted that the agglutinins, by fixing on agglutinable elements, induce modifications in the molecular attractions which unite these elements either to one another or to the circumambient fluid. The whole phenomenon of agglutination may be divided into two phases, the first of which may be produced experimentally without exciting the second. In the first the microbes, though scattered and far apart, come into contact with the agglutinin, which they fix. In the second, or period of agglutination properly so-called, the particles may present peculiarities

* Ann. Inst. Pasteur, xiii. (1899) pp. 465–79. Cf. this Journal, *ante*, p. 320.
† Tom. cit., pp. 426–39 (5 figs.). ‡ Tom. cit., pp. 225–50.

observable even in the aggregations of mineral particles. The phenomena of agglutination closely resemble those of coagulation.

The phenomena of true agglutination may be excited in limpid liquids when the particles are extremely divided. In a certain measure, and in view of their coagulating and dissolving properties, active serums and digestive juices have much in common. In fact, from a chemical point of view, immunity may eventually be regarded as a special case of the physiology of digestion.

The production of germicidal juices in vaccinated organisms is not to be regarded in a teleological sense. The organism merely brings into action forces already pre-existent and the special properties of the vaccine-serums existent in an inchoate state in fresh serums.

Biology of Cheese Ripening.*—Professors S. M. Babcock and H. L. Russell were unable to reconcile the many apparent discrepancies of the biological theory of cheese ripening, until they sterilised milk by the addition of mild antiseptics such as ether and chloroform, which could afterwards be removed, and thus avoid any changes which might be produced by boiling. Such milks, although sterile, underwent similar changes to those that occur in cheese. From this it is inferred that milk contains an unorganised ferment capable of digesting casein. This enzyme is inherent in the milk itself, and the authors succeeded in isolating it. This ferment, which plays an important part in the proteolytic changes that occur in the ripening of cheese, is named galactase.

Effect of Bile on Rabies.†—M. H. Vallée controverts the statement of Franzius that the bile of animals dead of rabies contains an antitoxin to rabies. The author's experiments point to the exact contrary. He also found that the bile of rabbits acts as an energetic antiseptic towards the rabid virus. An emulsion of virulent medulla oblongata is neutralised by an equal volume of bile in a few minutes.

The inoculation of a mixture of equal parts of rabies virus and of bile from a rabbit dead of rabies does not kill the animals, nor does it impart any immunity.

Pneumococcus and the Sleeping Sickness.‡ — Dr. E. Marchoux advances a novel theory to explain the disease known as sleeping sickness. According to the author, the sleeping sickness is a residuum after cerebrospinal meningitis of *Pneumococcus* origin.

The author's experiences are derived from official duties in Senegal, where pneumonia and cerebrospinal meningitis are apparently rife among the coloured people. The sleeping sickness is also not uncommon. The *Diplococcus intracellularis* Weichselbaum was not found in any of the cases, not even in those of cerebrospinal meningitis without pneumonia. The author adopted serum treatment in four cases, and in three of these with some apparent benefit.

Commensalism of Typhoid, Coli, and other Bacteria. § — Prof. E. Pfuhl shows that the typhoid bacillus can thrive on the same medium

* Proc. American Assoc. Advancement Sci., xlvii. (1898) pp. 420–1. Cf. this Journal, 1898, p. 333.

† Ann. Inst. Pasteur, xiii. (1899) pp. 506–12. ‡ Tom. cit., pp. 193–208.

§ Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 49–51.

in company with *B. coli communis* and bacteria from garden soil. The medium used was boiled potato. The observation is of some importance, for a pretty general opinion prevails that typhoid bacilli are soon suppressed by other bacteria when competing on the same medium.

New Pathogenic Microbe of Sewage.*—Dr. E. Klein isolated from the exudations of a guinea-pig which died after subcutaneous injection of fresh sewage, a bacillus varying in length from 0·6 μ to 1·25 μ, the breadth being about 0·4 μ. It is non-motile; it stains slightly in Gram. It grows slowly on gelatin, and does not liquefy the medium. It was also cultivated in agar and broth. It produces neither gas nor acid, and in fluid media it produces alkali. There is no odour from the cultures. It is pathogenic to guinea-pigs and mice, but not to rabbits. On account of its derivation from sewage and its pyogenic action, the new microbe is called *Bacillus pyogenes cloacinus*.

Spirillosis of Geese.†—Dr. J. Cantacuzène records his observations on the spirillosis of geese. These observations were undertaken for the purpose of ascertaining the truth of Gabritchewsky's statements or of refuting them. The latter accepted the humoral view, and ascribed the disappearance of the spirilla to the bacteriolytic action of the blood. The author, however, working in the laboratory of M. Metchnikoff, concludes that the bactericidal properties of the serum are only developed outside the organism, and the further from the natural condition the stronger are these properties. There is no relation in fact between the phenomena observed *in vitro* and those which take place in a living being. The spirilla are not destroyed in the blood. There is no englobement by phagocytes. The destruction takes place in the spleen and within the large macrophages of that organ.

New Diplococcus isolated from Horseflesh.‡—Herr H. G. van Harrevelt isolated a diplococcus from the muscle of a horse which had been slaughtered for enteritis. Occasionally it forms quite short chains, e.g. of four. It is somewhat smaller than *Streptococcus pyogenes*. It stains well with the ordinary dyes, but is decolorised by Gram's method. It grows well on the ordinary media, especially those derived from cattle. It thrives best when the reaction is acid. The growth is diminished by the addition of glycerin. Milk is coagulated. It does not produce sulphuretted hydrogen, but young cultures evolve the odour of boiled crabs. It does not produce gas. Gelatin is slowly liquefied. It does not form indol, nitrous acid, or pigment. The reaction of the cultures is alkaline, even on acid agar.

Guinea-pigs and rabbits resisted subcutaneous injection, but succumbed to intraperitoneal.

The diplococcus has much resemblance to *Micrococcus meningitidis equi*, but differs therefrom in being pathogenic to animals and in decolorising by Gram's method. From *Streptococcus* and *Staphylococcus* it is distinguished by the constancy of its *Diplococcus* form; from *D. lanceolatus* by its peptonising power; from *M. intracellularis meningitidis* by its peptonising power and greater pathogenic action on laboratory

* Brit. Med. Journ., 1899, ii. p. 69.
† Ann. Inst. Pasteur, xiii. (1899) pp. 529–57 (2 pls. and 10 figs.).
‡ Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 121–5.

animals; from *M. catarrhalis* by peptonising gelatin; and from *M. subflavus* by its shape, peptonising property, staining by Gram's method, and transmissibility to animals.

Acid-resisting Bacilli in Pus.*—Dr. A. Dietrich found in the pus from a suppurated ovarian cyst bacteria which he took to be tubercle bacilli, as they were quite resistant to acid and alcohol. No trace of tubercle was found in any other part of the body, and four guinea-pigs, inoculated with the pus, remained healthy.

Bacillus hastilis.†—Herr J. Seitz has often met with a thin rodlet in the oral cavity, which from its appearance he has designated *B. hastilis.* It may be pointed at one or both ends, or not at all. It may be curved, bulging in the middle, in pairs, chains, or heaps. It does not stain by Gram's method. In bouillon it gives rise to a smell resembling decayed teeth, or fæces, or garlic. It forms carbonic acid and sulphuretted hydrogen.

Cultivation of Leprosy Bacillus.‡—Herr M. Teich, by means of suitable media, has succeeded in cultivating from five cases of leprosy a bacillus which is resistant to acid and alcohol, and is apparently identical with the microbes cultivated by Bordoni, Uffreduzzi, and others. The bacterium is characterised by great polymorphism, which is determined by the properties of the cultivation media. On suitable media the bacteria grow in the form of thin rodlets, which are quite like the Hansen-Neisser leprosy bacillus. On less favourable media the shape varies from thin to thick oval rodlets, bulging in different places, or the forms may be diphtheroid and quite degenerate.

Bacillus fæcalis alkaligenes.§—Dr. A. Fischer remarks that *B. fæcalis alkaligenes* occurs more frequently than is supposed, and is probably often confounded with *B. coli communis* and the bacillus of typhoid fever. The litmus-milk test will serve to distinguish the organisms. It is sometimes important to discriminate *B. fæcalis alkaligenes* from *B. typhosus* ii. The formation of much acid or of alkali will demonstrate this, and hence the value of such a test. *B. fæcalis alkaligenes* is common not only in the intestine, but also in river water.

Newman's Bacteria.‖—Dr. G. Newman has ably responded to a general demand for a description of bacteria and their relations which should be at once popular, accurate, and up to date. The writer has aimed at describing bacteria especially as they are related to the economy of nature to industrial processes, and to the public health. A curt perusal will satisfy all but the hypercritical that the object has been attained. Dr. Newman has produced a book which is readable and scientific, and though full of facts, these are narrated in a lively way, so that even the purification of sewage and antitoxins become almost interesting.

* Berlin. klin. Wochenschr., 1899, No. 9. See Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 882–3.
† Zeitschr. f. Hygiene u. Infektskr., xxx. (1899) part 1. See Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) p. 929.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxv. (1899) pp. 756–61.
§ Tom. cit., pp 693–5.
‖ London, John Murray, 1899, xii. and 351 pp. (8 pls. and 70 figs.).

The contents of the book are divided into chapters dealing with the biology of bacteria—bacteria in water, soil and air; the relation of bacteria to fermentation, to disease, and their presence in and effect on food-stuffs. There is also an interesting account of immunity and antitoxins, and some remarks on disinfection.

Though the author disclaims all pretension to originality, it must not be supposed that the material is out of date; indeed, some parts are almost novelties, such as the description of the disposal and treatment of sewage. For those who desire a readable and trustworthy guide as to the merits and mischiefs of bacteria, Dr. Newman's work is eminently suited.

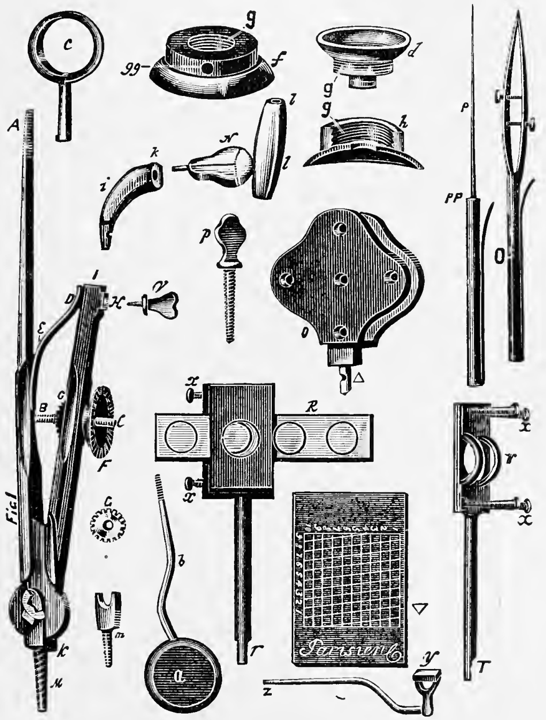
[The Publication Committee of the Journal has decided on resuming the issue of the Microscopic Bibliography, which was dropped on the lamented death of Mr. John Mayall, jun. It is intended in future to give at least the title of every work or paper (commencing from January 1st, 1899) coming under the head of Microscopy A or of Technique 3 (Microtomes); and we shall be much obliged to any of our Fellows who will call our attention to any such papers or articles published in Journals which are likely to escape our notice.—EDITOR.]

A. Instruments, Accessories, &c.*

(1) Stands.

The Compass Microscope.—In an old German work on the Microscope by Martin Frobenius Ledermüller,† occurs a series of plates illustrating Russwurm's "Universal Microscope," which appears to have been

FIG. 125.



a combination of compass and tube Microscopes in an unusual number of forms. Its claim to "universality" seems to have lain in its adaptability to viewing opaque, liquid, transparent, and anatomical objects.

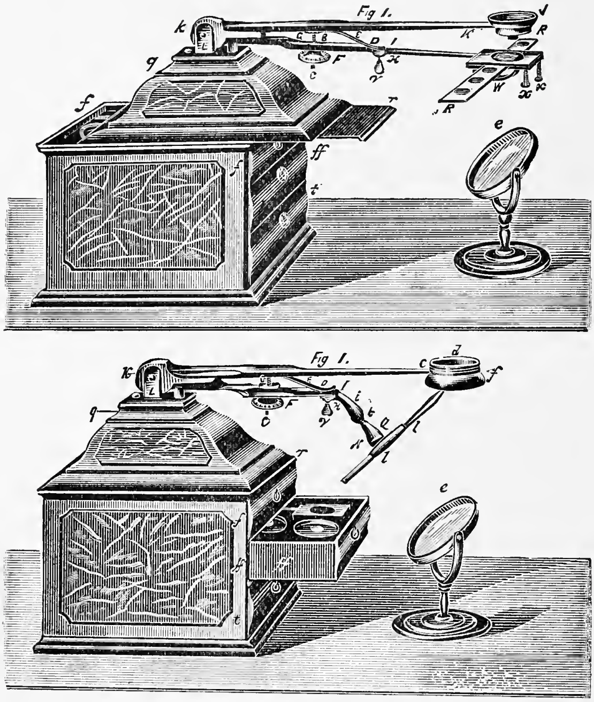
Figs. 125–129, reproductions of the original plates, show the in-

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

† 'Mikroskopische Gemüths- und Augen-Ergötzung,' Nürnberg, 1763; Sammlung ii. pp. 21–9 (pls. xi–xv.).

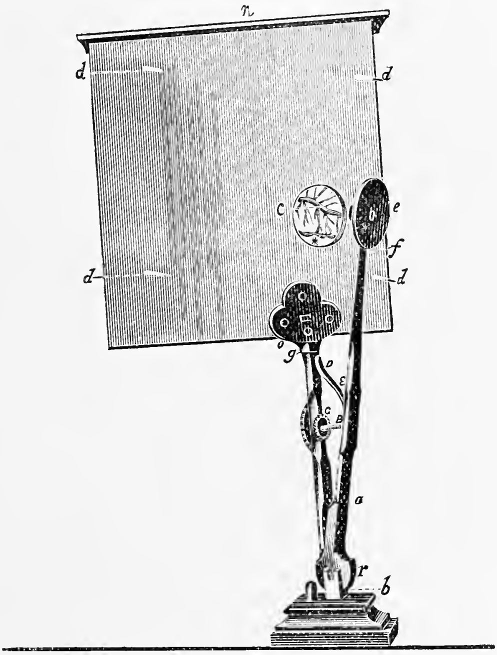
strument in its different forms so clearly that but little description is needed. Fig. 125 contains the compass, or skeleton of the apparatus, and the accessories, which will be recognised, in their various combinations, in the other figures. The parts, when fitted together and set upon the box-lid as a stand, made instruments suitable for viewing (1) transparent or liquid objects (fig. 126, upper), (2) opaque objects (fig. 126, lower), (3) anatomical objects (fig. 127). The Microscope was simple, and the only lens used was set in a circular frame *d*, inserted into a ring *c*. If the object was transparent or liquid (fig. 126, upper) this arrangement with the help of an adjustable glass mirror *e*, was sufficient; but in the

Fig. 126.



case of an opaque object, a perforated concave silver mirror *h*,*g* was screwed on to the under side of *d*, and the light, first reflected from the mirror *e*, was then again reflected on the object (fig. 126, lower). The screw-thread *g* for securing *h* to *d* was long enough for adjusting the focus of the concave mirror. Thus the opaque object was not only illuminated on both sides, but received a maximum of light from above. The concave mirror is shown in section at *h*, and in perspective at *f*; *g g* is the screw-hole for fixing lens-cap and mirror on to the compass leg. The little stage for holding the slides R was made of three plates, between the upper two of which the slides were placed, and the spiral springs on the pins *x* acted as clamps. The curved bars under the lower plate were for a glass tube of liquid, and in this case the springs clamped the two lowest plates. Two reversible tablets (Y, *a*), white one side, black the other, were provided for opaque objects. The reversibility was attained in Y (a small round ivory tablet) by suspending it on two small pivots in a brass bracket at the end of the crooked arm *z*. With the large tablet *a*, reversibility was attained by a single pivot, and the arm *b* was crooked so as to make *a* always horizontal. O is a pair of forceps also intended for opaque objects. The micrometer ▽ is a Parisian inch divided into a decimal scale, and was intended for estimating the magni-

Fig. 127.



fying power. The whole apparatus was fitted on the lid of a box, which contained drawers for the reception of the various parts when not in use.

Fig. 127 shows the "anatomical" arrangements, after the manner of Lieberkühn's "Anatomical Magnifying Machine" (1745). At the back of a board a frog's web or other such object was spread out, and the lens of the Microscope arranged so as to explore all the parts opposite the perforation.

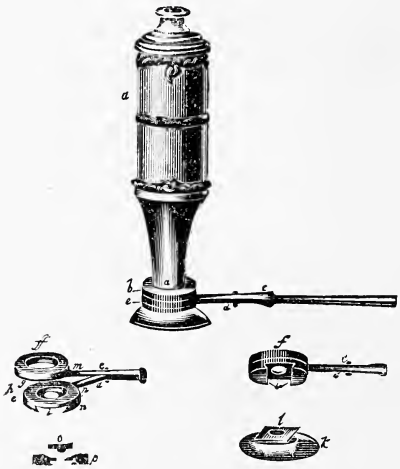
Fig. 128 shows how an extension of "universality" in the form of a tube Microscope could be arranged for those who preferred such an instrument. The tube was screwed into the ring *b*, and a second ring working radially from a centre-joint *d* received the lens. This second ring could be swung aside and the lens changed when desired; the concave perforated mirror could be slid into a notch in the lower face of the ring. The details are shown in separate cuts: *o* in the left-hand lowest cut is the lens. There was no eye-piece, the length of the tube being merely a guide for the position of the observer's eye.

The lamp and stand, depicted in fig. 129, appear to have been Russwurm's idea, although (as he admits) the glass globe filled with water was adapted from the method of Hooke (1660).

The date of the letter in which Russwurm sends the drawings of his Microscope to Ledermüller is December 5, 1761.

Adams' Compendious Pocket Microscope.—The cut of this old Microscope (fig. 130) is copied from the 'Micrographia Illustrata' by G. Adams, 4th edition, 1771. It is interesting to note that this is the model to which Benj. Martin added his improvements in 1776.* It will

FIG. 128.



be observed that both have folding tripod feet; both have compass joints at their bases for inclination; both are body focussers by rack-and-pinion; both have body movements over the stage by lateral swing in arc and sliding bar, after the plan of Ellis' Aquatic Microscope (made by Cuff in 1755). Adams calls this Microscope an abridgment of his Variable Microscope; now this Variable Microscope, which was first described in this same edition of the 'Micrographia,' was, we are told by Adams, designed by a nobleman who did not wish his name to be published; and as this Variable Microscope more nearly conforms to the Microscopes of the present day than any of those preceding it, microscopists ought to be much indebted to this anonymous nobleman for the form of the instruments they now use.

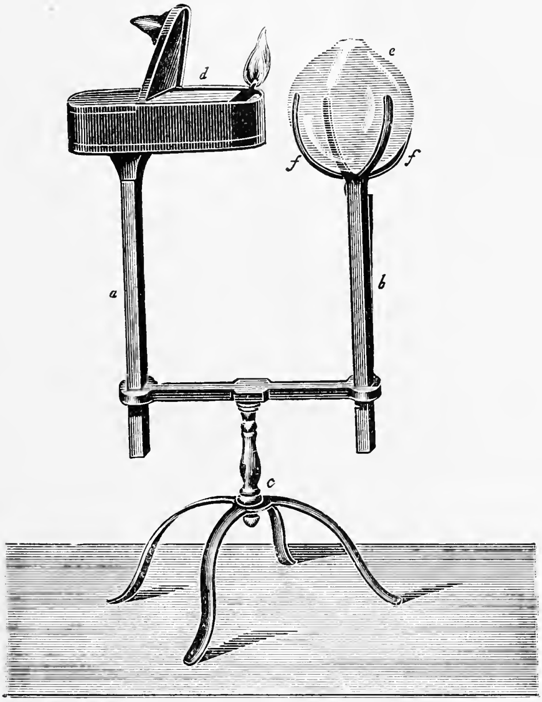
The main alteration that we find in the Compendious Pocket Microscope is a radical one, and consists in the transference of the compass

* See this Journal, *ante*, p. 326, fig. 73.

joint from the top of the pillar to the bottom; this from our present point of view must be considered a retrograde step.

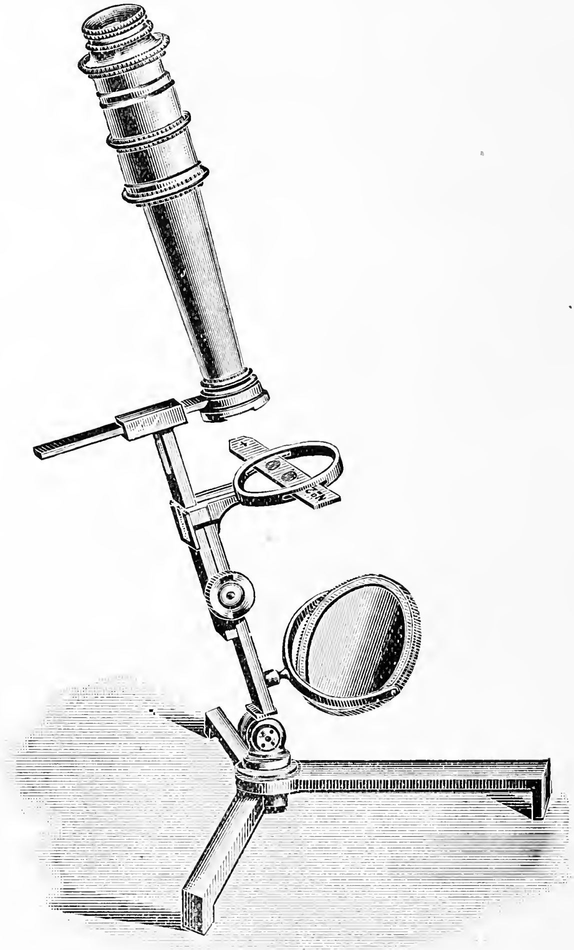
This Microscope is, as we have already mentioned, a body focusser, so also was the Variable; but the Variable was hampered with a fine adjustment movement mounted on the same slide; therefore a clamping nut had to be released to throw the fine adjustment out of action when the rackwork coarse adjustment was used. There can be no doubt that the suppression of the fine adjustment effected an improvement; for a good rackwork coarse adjustment was quite sufficient to focus any non-achromatic objective of that time.

FIG. 129.



The optical part of this Microscope was similar to that of the Variable, and consisted of a double eye-lens, a field-lens, and another lens lower down the body, which, as we have stated before, formed the back lens of the objective, the alteration in power being effected by changing the front lens of the objective only. It is probable that this arrangement of the optical part of the instrument was due to Benj. Martin; though, so far as is known, the first publication of it is in the account of the Variable Microscope. At the end of the nose-piece a dove-tailed slot is seen, into which slides a plate containing six powers. This is the first instance we have of such a contrivance fitted to a compound Microscope; but it will be remembered that a sliding plate of powers was employed by G. Lindsay * in his simple Microscope, patented in 1743, but alleged to have been made as early as 1728. These are all the points to be re-

Fig. 130.



corded in this instrument; it will, however, be of interest to compare it with that of Benj. Martin.

In the optical part we noted that Benj. Martin doubled the field-lens

* Journ. Quekett Micr. Club, vii. (1898) p. 115, fig. 22.

of his eye-piece, with the view of reducing the spherical aberration. By mounting the objective fronts in a wheel instead of in a slide, Martin effected a great improvement, and so became the inventor of that useful appendage, the rotating nose-piece.

Now, as these early Microscopes were largely used as simple Microscopes, a long extension of rackwork would be necessary, which, judging from the cut, the Compendious Pocket Microscope certainly did not possess, and it is more than probable that the draw-piece added by Martin was for the purpose of remedying this very defect.

The improvements effected by Martin in substage and superstage illumination were of course a distinct advance.

In conclusion, Adams' Compendious Pocket Microscope is important because it undoubtedly led up to Martin's model of 1776, which was one of the best and most practical of old non-achromatic Microscopes, and of which, thanks to Dr. Dallinger, we have such a fine example in our Cabinet.

Fine Adjustment of the Microscope.* — A treatment, mainly historical, of this subject appears over the signature "M." At the commencement of this century, micrometer movement was confined to the stage; for the last forty or fifty years it has been applied to the upper part of the stand. Such stands, closely resembling those in present use, were already constructed in 1839 by Charles Chevalier, and improved by his son Arthur Chevalier. Strauss' "Grand Microscope" possessed coarse and fine adjustment, rotatory object-stage, and a movable slide in each direction, besides apparatus for central and oblique illumination, a reflecting mirror for incident light, a camera lucida, an objective stage micrometer, and an eye-piece micrometer. The tube was mounted on a horseshoe foot, and arranged for oblique inclinations. The well-known Parisian opticians, Trécourt, Bouquet, and Oberhäuser, worked to this model, and in 1857 the latter entered into partnership with his nephew, E. Hartnack, who since 1860 has conducted the business alone. Oberhäuser and Hartnack then for a long time controlled Microscopy, because they produced a combination of the best mechanical execution and optical design. By means of his immersion system of 1860, No. 10 with 1·6 mm. focus, and No. 11 of the year 1864 with 1·2 mm. focus, Hartnack surpassed all known objectives (even the English), which possessed even a smaller focus but a much smaller interval (*Abstand*), and were therefore not so well adapted for practical use.

The first large system, No. 11, was produced by Hartnack for Prof. Henry von Heurck in Antwerp, who has published a very favourable report upon it in the first volume of the 'Annales de la Société Physiologique d'Anvers.'

By means of these stands the original micrometer movement of the stage was quite superseded; all better instruments were provided with a fine adjustment, which was placed in the arm of the tube-holder.

Only cheap stands now show a fine adjustment by oblique movement of the object-stage; obviously this cannot be applied to stronger systems, because the object must lie nearer to the upper lens aperture than to the lower, and consequently cannot be symmetrically adjusted.

* Zeitschr. f. angew. Mikr., July 1898, pp. 86–90.

However, on old stands by Plössl, Merz, Goring, Pritchard, and others, it may be seen how for a long time the greatest trouble was taken to bring the fine adjustment of the object-stage to an exact and practical perfection. So long as the stands are restricted to the usual dimensions, there is no reason in particular for compelling us to abandon the good and sure movement by prism adjustment; but if the dimensions of the stand should be increased, then necessity would compel us to again fit the adjustment to the stage. These ideas have occupied the author for some years; and at last Herr Paul Thate, of Berlin, has constructed for him a small model of this movable micrometer stage. The object-stage has a diameter of 20 cm., and might have more—a size which, although necessary for the observation of large sections, would yet render a suitable stand very massive and awkward.

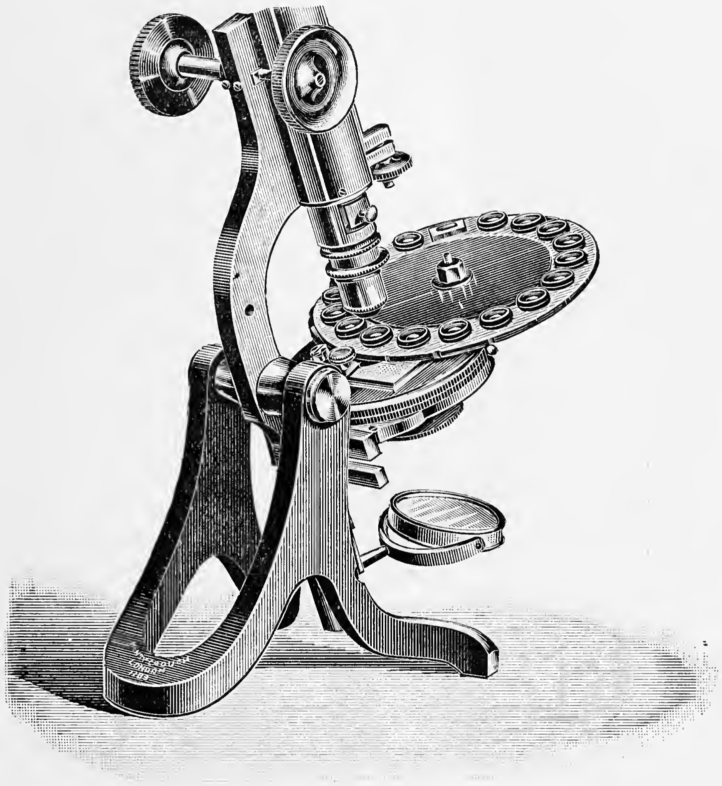
For such an instrument the Pacini model of 1845 offers itself as a suggestion. The tube is set on a three-sided prism, so that the rays which have passed through the object are reflected at an angle of 30°, and hence the oblique position of the tube need not be worked by means of the movement of the stand. Thus the great advantage is gained of being able to place the preparations horizontally. Pacini moves the stage by a micrometer-screw, which is fastened to the stand, and possesses a short inclination to the movable disc. This micrometer movement is not exact enough to satisfy modern demands. If the stage is moved, it is obviously required that every movement of the stage must be strictly central. There must be no shaking of the object; there must be steady up-and-down motion, without being in the least brought out of the axial setting. Such a motion can be attained by fitting an inner cylinder to the object-stage, and fixing it with clamps, so that it can be moved up and down by means of a screw-disc. This screw-disc is placed round the cylinder and fixed in a slot, so that the rotation of the screw raises and lowers the cylinder. The larger the dimensions the finer is its movement, and every difference in height can be read off on the disc, which is provided with scales. The mechanical arrangement is less complicated than other contrivances which have been, and perhaps will yet be, applied to the upper stand if the need for large stands should become more marked. It is already a hindrance that the movable tube hangs on the same part which encloses the whole fine adjustment, and many a micrometer movement has been ruined by inadvertently lifting the Microscope by the arm. But the beginner will always use the arm for gripping the Microscope.

The application of the Porro system to microscopy will give a further stimulus to the production of new stands. The oculars will first be constructed out of prisms, which, just as in the case of telescopes, will procure their highest optical adaptability, and similarly will permit a shortening of the tube, and will attain with the strongest magnification a brilliant and large field of view. One ought to see the attention of the up-to-date Microscope constructor directed to the combination of Porro's oculars with large object-stages and with the most delicate adjustment motion of the object-stage.

We are by no means at the end of the constructive adaptability of our optics and mechanics, and many a discovery yet slumbers in the workshops of our Microscope makers.

Flint's Class Microscopes.*—Dr. James M. Flint has devised these instruments for class or public exhibition of slides not requiring very high magnifying powers. Dr. Flint says that his first appliance for this purpose was an accessory to the ordinary Microscope stand, and consisted of a circular plate of pasteboard (fig. 131) made to revolve upon a pivot attached to the stage, the plate carrying a series of objects mounted upon small discs or small squares of glass; but this arrangement

Fig. 131.



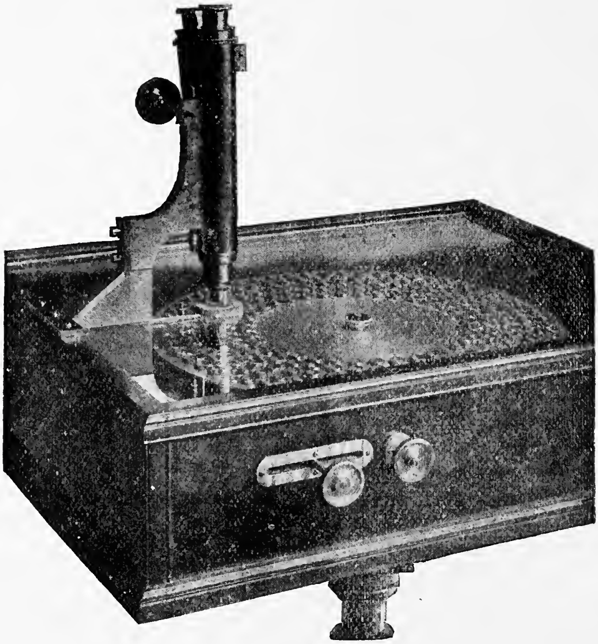
was only suitable for class use under the immediate supervision of the instructor.

Fig. 132 shows the form of the instrument adapted for public use. The principle of the rotatory stage has been developed by enlarging the circular plate, enclosing it securely in a box with a glass top upon which the Microscope is fastened, giving a rotatory motion to the stage by means of a friction roller operated by a rack-and-pinion controlled by another milled head in close proximity to the former. By a com-

* Ann. Report of Smithsonian Institute, 1896, pp. 96 and 7 (4 pls.); Scientific American, May 6, 1899, p. 282 (3 figs.).

bination of the two movements any portion of the plate may be brought under the Microscope, and any number of objects arranged thereon may be brought into the field in succession. The objects being enclosed in the box are secure from injury; the movement of the Microscope for focal adjustment is limited by stops, so that the object cannot be entirely lost to view; the eye-pieces are screwed in so that they cannot be stolen, and the instrument is practically safe from everything but malicious mischief. The instrument was made originally for exhibiting foraminifera, which were mounted in concave brass discs without stems for insertion in the holes of the rotatory stage. For transparent objects the

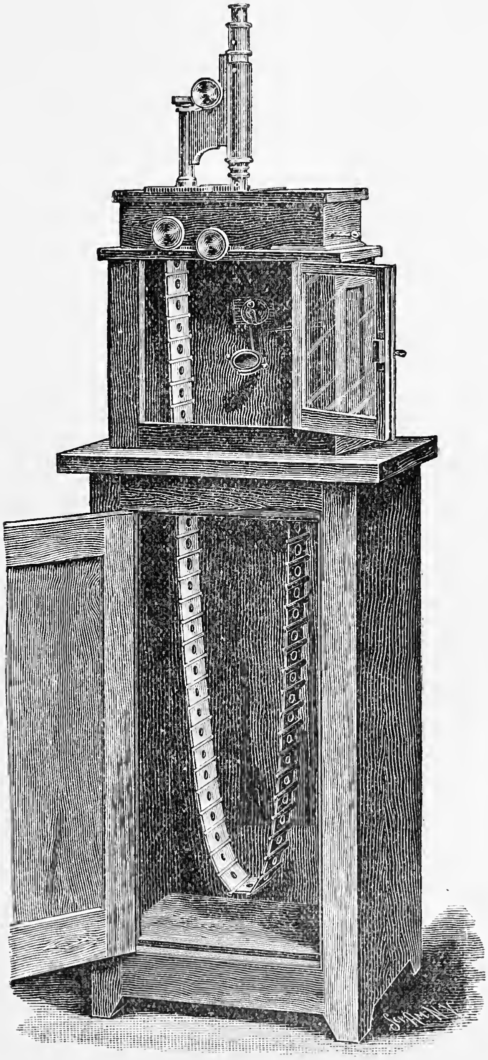
Fig. 132.



stage must be perforated for upward reflection of the light from the mirror below. The instrument now in use in the museum was made in the year 1890, has been modified in a few details since, and has successfully endured manipulation by thousands of inexpert hands of children as well as adults, without injury, and this without attendant supervision of any kind.

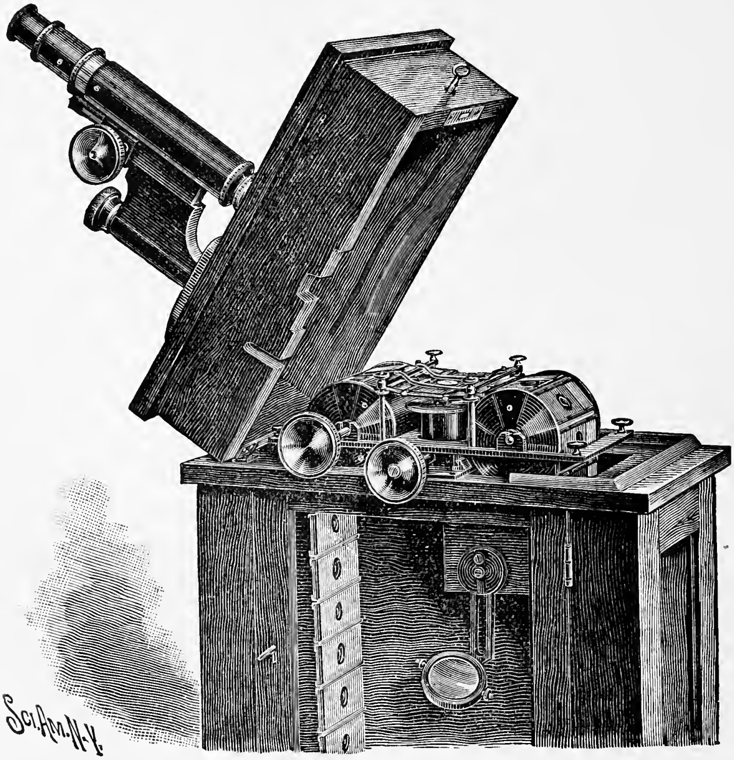
In figs. 133, 134, Dr. Flint shows a different form of apparatus intended for the exhibition of series. An indefinite number of slides are attached to an endless band of linen by means of thin brass holders which allow the slides to be changed when desired. This linen band passes over two rollers mounted upon a light brass frame which occupies the place of the stage of an ordinary Microscope. The loops of the band hang free. One of the rollers has a projecting pivot with a milled head by means of which it may be rotated, and the two rollers are connected by a narrow belt at each end. As the rollers are made to revolve,

Fig. 133.



the band carrying the slides passes horizontally under the Microscope, resting meanwhile upon the two narrow belts, and being kept at a definite distance from the objective of the Microscope by two guides, which press upon the slides from above. The brass frame rests upon a grooved bed-plate which permits a lateral movement of the frame. This lateral motion is controlled by a screw, operated by means of a second milled head in convenient proximity to the one giving the to-and-fro motion. The advantages of this form of apparatus are that ordinary glass slides may be used, and that the focal distance is not disturbed by differences in their thickness. The only disadvantage is that the mechanism is somewhat more delicate and complicated than in the other instrument, and requires some little protection from the thoughtless violence of

Fig. 134.



curious children. Microscopes copied from the original have been in use for several years and have proved perfectly satisfactory.

The writer in the *Scientific American* describes a valuable improvement intended to prevent injury to the instrument from violent twisting of the milled head, which controls the lateral movement of the frame after the frame has been brought up against the stops in either direction. This is effected by slightly tapering the pivot of the screw governing the movement, and attaching the head by friction only, the amount of friction being regulated by a set-screw in the end, so that, before a dangerous strain can be put upon the frame, the head turns harmlessly upon the pivot.

An earlier form of the instrument was described by Dr. Flint in 1892.* Another inventor of a rotatory disc was Dr. Taylor, whose device was noticed in our Journal.†

For the illustrations to this abstract we are indebted to the courtesy of the editor and publishers of the *Scientific American*.

HAGER, H.—**Das Mikroskop und seine Anwendung.** (The Microscope and its Application.)
8th edition, by C. Mez. Berlin (Springer), 1899, 8vo, 335 pp. and 326 figs.

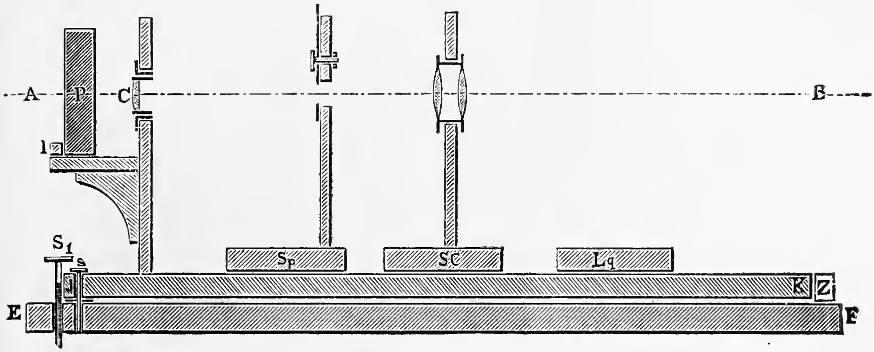
LEISS, C.—**Die optischen Instrumente der Firma R. Fuess, deren Beschreibung, Justirung, und Anwendung.** (The optical instruments of Messrs. R. Fuess: their description, adjustment, and application.)
Leipzig (Engelmann), 1899, 233 figs. and 3 pls.

(3) Illuminating and other Apparatus.

Köhler's Apparatus for Uniform Illumination.‡—The object of this apparatus, manufactured by Zeiss, is to provide an easily made cheap arrangement for obtaining uniform illumination from the spectrum itself. It is therefore independent of light-filters.

Figs. 135, 136 give the section and ground plan. D E F G is a

FIG. 135.

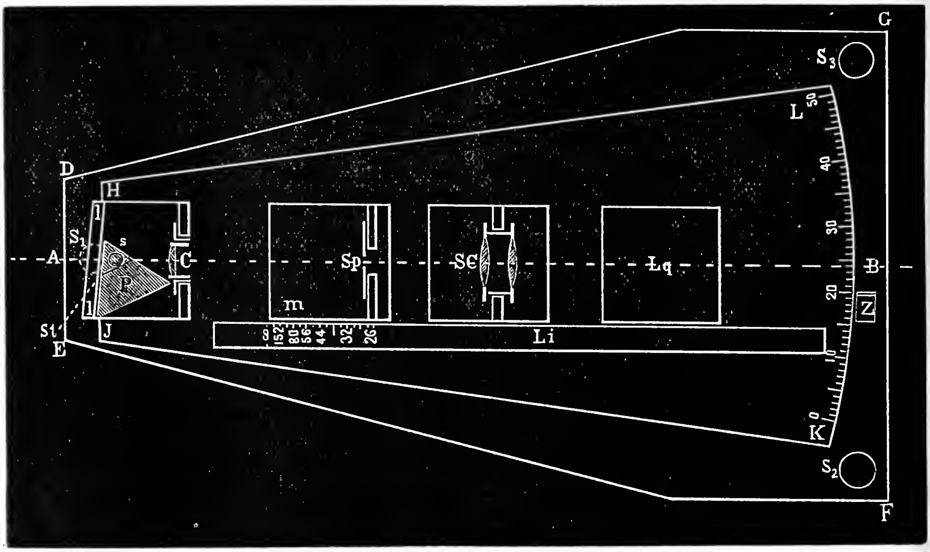


board, about 60 cm. long, on which the apparatus is placed. It is about 2 cm. thick, and is made of three thin boards glued together cross-grained to prevent warping. The side D E is 12 cm. long, and has a levelling screw S_1; at the end F G, 40 cm. long, are two other levelling screws. These screws, which are 6 to 7 cm. high, allow not only levelling but considerable adjustment in height. On this base-board is placed the sector H J K L, consisting also of three thin boards glued together cross-grained. K L is an arc, capable of being rotated about the pivot *s* in H J. In order to separate the planes of the sector and base-board, the pin *s* is passed through a little disc, and two similar discs are placed at

* Proc. Amer. Soc. Micr., xiii. (1892) pp. 54–8 (1 pl.).
† Tom. cit., p. 30 (1 pl.); Journal R.M.S., 1892, pp. 862–3 (fig. 94).
‡ Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 1–29 (5 figs.).

L and K. At the front end of the sector, rather close to the axis of rotation, is erected the carrier of the collector lens C, consisting of a slab 20 by 9 cm., perpendicularly fastened to the sector, and pierced at a convenient height by a circular opening in which the collector lens is set; the centre of this opening must be brought by means of the levelling screws to coincide with the optical axis of the Microscope used. The author employs for his collector the objective of a small opera-glass, of 12 cm. focus and about 2·5 cm. diameter. In front of the lens a small bracket, 7 by 9 cm., is applied to the carrier, and on it is placed the carbon disulphide prism P, of 60° angle and side-planes 9 by 6 cm. The prism is set close up to the collector, so that it is in the position of minimum aberration for blue, and is exactly over the rotation axis *s*. A fillet *l l* is screwed on to the bracket, against which the side-plane of the prism

FIG. 136.



must lie, in order to avoid the necessity of determining the adjustment on every occasion.

The other carriers must be capable of a sliding adjustment in the axis of the apparatus, and for this purpose they are secured, not on the sector, but on square foot-blocks of about 9 cm. square. Each of these blocks is fitted with three small knobs, so that they may stand steady without vibration; their edges must always be in contact with the graduated bar L *i*. On the first slider is a perpendicular board with an adjustable slit, or a revolver frame with several slits, of breadth varying between 0·1 and 3 mm. The second slider is similar, but, instead of the slit arrangement, carries a non-achromatic two-lensed system S C, the "slit collector," of about 3·5 cm. aperture and proportionately greater focus. The last slider L *q* is for the light-source, usually a small acetylene burner on a heavy lens-stand for convenient up-and-down adjustment; but other light-sources can of course be used.

The arrangements for adjusting and focussing the apparatus are of the usual character, and are described in full by the author.

Light of any required refrangibility can finally be received on the objective of the Microscope. The author claims that the advantage of being able to work with any part of the spectrum outweighs the laboriousness of fitting up the apparatus, which however need occur but once, as the positions of the parts could be registered on the scale.

SCHROEDER, DR. HUGO—**Ueber Beleuchtungsprobleme.** (On illumination problems.)

[A series of discursive articles.]

Central-Ztg. f. Optik u. Mechanik, 1899, Nos. 2–7, Jan. 15 to April 1.

(4) Photomicrography.

MARKTANNER-TURNERETSCHER, GOTTLIEB, F.R.M.S.—**Fortschritte aus dem Gebiete der Mikrophotographie.** (Progress in the department of photomicrography.)

[This is the publication in pamphlet form of a section of Dr. J. M. Eder's 'Jahrbuch für Photographie und Reproductionstechnik für 1899.' The author has compiled an illustrative descriptive list of the various instruments, books, &c., on the subject issued during the last two years. The list is cosmopolitan, and most of the items have been noticed in our Journal.]

SOBOTTA, DR. J., of Würzburg—**Ueber die Verwertung von Mikrophotographien für die Untersuchung und Reproduktion mikroskopischer und embryologischer Präparate.** (On the value of photomicrographs for the examination and reproduction of microscopical and embryological preparations.)

[In two chapters: (i.) The photomicrography of preparations of the central nervous system with Weigert's boundary colours; (ii.) The photomicrography of opaque objects.] Munich, 1899, 34 pp. and 1 pl.

(6) Miscellaneous.

BABES, V.—**Bemerkungen über demonstrative Vorträge und über Projectionstechnik.** (Observations on proposed methods of demonstration and on projection technique.)

Centralb. f. allgem. Pathol. und pathol. Anat., Bd. X. (1899) No. 6, p. 233.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Preparing Agar.†—Mr. W. W. Alleger gives the following method for preparing agar. Rub up 10 grm. of powdered agar and Witte's powdered pepton and 5 grm. of sodium chloride in a porcelain saucepan with water sufficient to form a thin paste. Add gradually, while stirring the mixture, 500 ccm. of water, and then heat until the agar is dissolved. To the juice from 500 grm. of lean meat add 500 ccm. of water, and then mix with the agar solution, which, while hot enough to remain fluid, should have cooled sufficiently not to coagulate the albumen in the meat-water. Neutralise with 4 per cent. of caustic soda; boil the mixture until all the albumen has coagulated, and then, if necessary, correct the reaction and fill up with boiling water, after which filter

* 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, &c.; (6) Miscellaneous.

† Trans. Amer. Micr. Soc., xx. (1899) pp. 91–5.

through paper. By deferring filtration to the next day the filtrate will be clearer.

The chief feature in this method is the preliminary step of moistening the powdered agar and pepton with a small quantity of water or bouillon, and rubbing to a smooth paste free from lumps.

Magnesia-Gypsum Plates for Cultivating Nitrifying Organisms.*—Herr V. Omeliansky states that he has obtained excellent results from cultivating nitrite-forming organisms on gypsum blocks saturated with Winogradsky's solution (*vide infra*). A perfectly uniform mixture of gypsum and carbonate of magnesia is prepared of the consistence of sour cream. This is then poured out on to a glass plate, and when it has become of a doughy consistence, is cut up into circles for Petri's capsules, and into strips for test-tubes. The circles and strips, properly smoothed off are placed in capsules or tubes along with mineral solution, and, after being properly sterilised, are inoculated with nitrite-forming organisms. Growth is first visible in four or five days, the colonies being of a yellowish hue, ultimately becoming brownish.

Cultivation Medium for Spirillum volutans.†—Dr. Vogt obtains copious development of *Spirillum volutans* on the following medium. Peas are boiled in water (1–5) for about 5 minutes, and the fluid strained through a linen cloth. To the pea-water are added 1 per cent. each of pepton, sodium chloride, and carbonate of ammonia. Even without the pepton *S. volutans* thrives on the medium, but sodium chloride and carbonate of ammonia are indispensable. The mixture must now be allowed to stand for some days—in fact, until it begins to decompose—before it is sterilised. If it be sterilised as soon as it is made, the spirillum does not find the medium suitable to its needs.

Cultivating Leprosy Bacilli.‡—Dr. J. Barannikow, in a preliminary communication, states that he has successfully cultivated typical leprosy bacilli from two cases. The material used was nasal secretion, sweat, and blood. Rapidity of growth was found to depend chiefly on suitability of medium. Skin, brain, and ascitic fluid were favourable starting media. On suitable media rodlets were found in 36–48 hours. Agar and gelatin containing substances suitable for the bacilli produced colonies at 17°–18° C. by the fourth day. If the medium was unfavourable, no growth took place even at body heat.

(2) Preparing Objects.

Methods used for Chilopoda.§—O. Duboscq devotes a special chapter in his paper to technique. He usually killed his specimens with chloroform, cut them in fragments, and fixed with Flemming's solution or Perenyi's liquid. For the latter he used the following formula:—Equal parts of 1 per cent. chromic acid, 10 per cent. nitric acid, and 95 per cent. alcohol. He also used acetic alcohol made as follows:—10 parts of glacial acetic acid and 100 parts of absolute alcohol; this kills animals instantly in an expanded condition. For staining after Flemming's solution, he recommends safranin in a saturated solution in

* Centralbl. Bakt. u. Par., 2te Abt., iv. (1899) pp. 652–5.
† Op. cit., 1te Abt., xxv. (1899) pp. 801–4.
‡ Op. cit., 1te Abt., xxvi. (1899) pp. 113–4.
§ Arch. Zool. Expér., vi. (1899) pp. 481–650 (7 pls. and 21 figs.).

water containing anilin, differentiation being effected by alcohol and essence of cloves, or picric acid dissolved in absolute alcohol, or Benda's light green. After Perenyi's liquid or sublimate, he used the following method:—Overstain with Delafield's hæmatoxylin, decolorise with nitric acid of 0·5 per cent. strength, or with very dilute Perenyi's fluid, wash with water, stain with alcoholic eosin.

For the study of the blood, the following liquid was used:—Acetic acid, copper acetate, copper chloride, osmic acid, thionine, 1 grm. each; distilled water, 400 grm. This is added to the blood on a slide, and both fixes and stains after about two minutes.

For the study of the nervous system, he used the following method instead of that of Golgi. The preparations were placed for 48 hours in the following:—5 per cent. solution potassium bichromate, 3 parts; 20 per cent. formol, 1 part; and then for 24 hours in 1 per cent. nitrate of silver solution, both solutions being kept at 40° C.

Isolation of Nitrification Microbes from the Soil.*—According to Herr V. Omelianski, the media suggested by Winogradsky are the most suitable substrata for isolating nitrification microbes, silicon jelly for nitrite-formers, and nitrite-agar for nitrate-formers. For making silicon jelly it is necessary to use soluble water-glass (sp. gr. 1·05–1·06) and hydrochloric acid (sp. gr. 1·10). A mixture of equal parts is made and dialysed until the chlorine reaction is no longer given with silver nitrate. Besides the foregoing, the following solutions are required:—

Solution i. Potass. phosph. 1 grm.; ammon. sulph. 3 grm.; mag. sulph. 0·5 grm.; aq. dest. 1000 ccm.

Solution ii. Ferri sulph. 2 per cent.

Solution iii. Saturated solution of sodium chloride.

Solution iv. Magnesia-milk, i.e. a suspension of carbonate of magnesia.

To 50 ccm. of the silicic acid solution, 2·5 ccm. of the first and 1 ccm. of the second solution are added. A loopful of salt is required for each plate, and as much magnesia-milk as will impart a milky appearance to the jelly. The plates are best inoculated by rubbing a drop of the inoculation fluid on the surface by means of a glass rod.

The nitric acid reaction appears about the fifth or sixth day. To render the colonies apparent on the milky surface of the plate, a solution of ammonia is used. A couple of drops of a 10 per cent. solution are placed in two small excavations cut in each plate.

For isolating nitrate-formers, the following media are used in the Imperial Institute at St. Petersburg. A liquid medium is composed of natr. nitros. (Merck) 1 grm.; natr. carbon. ustum 1 grm.; kal. phosphor. 0·5 grm.; natr. chlorat. 0·5 grm.; ferrum sulph. 0·4 grm.; magn. sulph. 0·3 grm.; aq. destil. 1000 grm.

A solid medium has the following composition:—Natr. nitros. (Merck) 2 grm.; natr. carbon. ustum 1 grm.; kal. phosph. a trace; agar 15 grm.; water 1000 grm.

Demonstrating the Spirilla of Geese.†—Dr. J. Cantacuzène states that he obtained good results from the following method:—(1) Small

* Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 537–49 (1 pl.).
† Ann. Inst. Pasteur, xiii. (1899) pp. 534–5 (2 pls.).

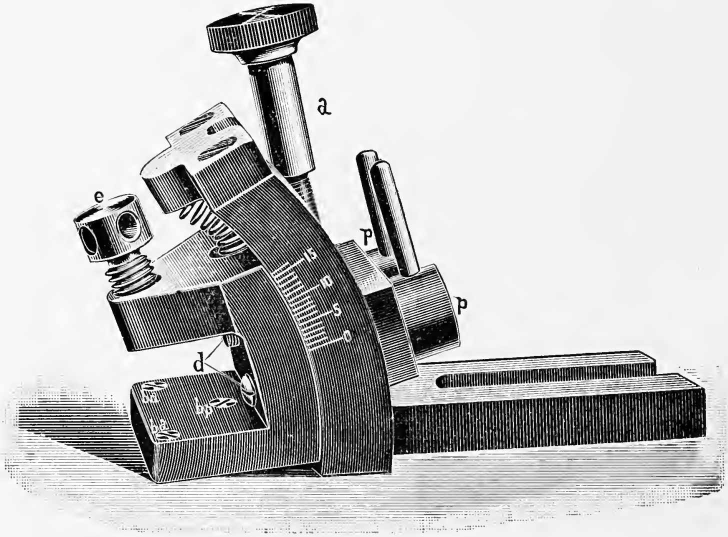
pieces of the organs were immersed in weak Flemming for 24 hours. (2) Wash in water for 24 hours. (3) Series of alcohols, xylol, paraffin imbedding. (4) The sections fixed to the slide were stained with the following fluid :—Ziehl's fuchsin 2 parts; neutral glycerin 1 part. The sections should not be thicker than 3–4 μ, and must be left in the stain for 24 hours. Instead of fuchsin, magenta-red may be used. (5) Wash quickly in water; remove excess of water with blotting-paper, then immerse the preparation in a series of ether baths to prevent dehydration by the alcohol. The immersion should last 4–6 hours. (6) Mount the sections in balsam dissolved in ether.

The author found that all fixatives, except those containing osmic acid, gave very imperfect staining results.

(3) Cutting, including Imbedding and Microtomes.

Jung's New Knife-holder.*—Messrs. Mayer and Schoebel describe some improvements in Jung's microtome knife-holder. These improvements consist in the addition of (1) a pair of screws *d*; (2) a triplet of screws *b p*, *b a*, *b d* (fig. 137). The first set can be drawn out some

FIG. 137.



5 mm., so that a blade narrower than the usual 34 mm. can be used. A second set can be raised so as to permit the insertion of a thinner knife-blade; moreover, by unequal arrangement in height they can be made to influence the inclination of the knife, and the front ones allow an adjustment for attaining a more perfectly horizontal section.

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 29–32 (2 figs.).

(4) Staining and Injecting.

New Group of Anilin Pigments, and their Applicability to Tissue Staining.*—Herr H. Rosin has discovered that if saturated aqueous solutions of an acid and an alkaline anilin pigment be mixed so that the mixture have a neutral or approximately neutral reaction, a precipitate occurs. This precipitate is extremely bulky if the correct proportions have been observed, and may be partially or wholly dissolved if either the alkaline or acid pigment be again added in excess. These precipitates are obtained by mixing aqueous solutions of eosin or erythrosin and methylen-blue, of methyl-orange and methyl-green, of rubin and malachite-green, of picric acid and methylen-blue or magenta-red, &c.

All these precipitates are of a crystalline nature, and, while almost insoluble in water, are quite soluble in alcohol. From these solutions they can be re-obtained in crystalline form by concentration of the solutions or by the addition of water. Of all the foregoing the most useful is the eosin-methylen-blue mixture which makes with alcohol a blue-violet solution. When tissue-sections are stained with this, the nucleus is blue and the plasma red. Nerve-cells, however, form an exception; for while the plasma stains red, the nucleus does not stain blue, the blue being picked up by the Nissl bodies. The neutrophile granules of leukhæmia stain violet. As a rule, with this pigment, acid substances become blue, alkaline red, neutral violet.

New Vegetable Pigments for Microscopical Technique.†—Dr. M. Claudius recommends for microscopical technique stains made from flowers and fruits. The most suitable flowers will be found in certain dahlias, while the blackberry and elderberry are the most convenient fruits. The flowers and fruit must not be crushed, and must be quite fresh. The pigment is extracted by boiling in spirit and filtering when cold. The filtrate is inspissated by evaporating off the spirit, and then the strong pigment solution is diluted with water. The most suitable strength is found to be when 100 ccm. of pigment is prepared from 100 grm. of fruit. The solution must now be acidulated by adding 1 ccm. of 25 per cent. sulphuric acid to every 100 ccm. of the staining solution. The acid reaction is absolutely necessary, as this kind of vegetable stain does not work when alkaline or neutral. Ten drops of carbolic acid are added, and then the solution is shaken up and filtered. The sections are immersed in the solution for a couple of minutes, washed in absolute alcohol, cleared in oil of cloves, and, having been treated with xylol, are mounted in balsam. These vegetable stains may also be combined with picric acid or methyl-violet, and thus a double and triple staining may be imparted. To 100 ccm. of the elderberry stain, 5 ccm. of cold aqueous solution of picric acid are added.

When methyl-violet is to be used in conjunction with the picric-acid-elderberry solution, the following procedure is advised:—(1) Stain with a 2 per thousand aqueous methyl-violet solution for 1–2 minutes, and then remove superfluous staining solution. (2) Stain for 2 minutes in the picric-elderberry solution, and again remove any superfluous fluid.

* Berliner klin. Wochenschr., 1899, No. 12. See Centralbl. Bakt. u. Par. 1te Abt., xxvi. (1899) pp. 101–2.

† Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 579–82.

(3) Dehydrate in absolute alcohol. (4) Decolorise in clove oil until the red nuclear stain shows pretty well. (5) Xylol. (6) Balsam.

By this method the nuclei are stained red, the plasma yellow, and bacteria, stainable by Gram's method, indigo-blue. If not stainable by Gram's method then the bacteria are red.

For very thin sections, dehydration in alcohol is hardly necessary, and merely mopping with blotting-paper may be sufficient. For cover-glass preparations the use of alcohol is to be avoided.

New Staining for Nervous Tissue.* — Herr P. Kronthal stains sections of brain and cord by immersing them in a mixture of equal parts of 10 per cent. formalin and saturated formate of lead solution for five days, and then for a similar period in sulphuretted hydrogen and formalin solution. The sections are then washed, treated with alcohol and xylol, and imbedded in balsam. Not only the ganglia and nerve-cells, but the finest branches of the nerves, show a deep brown impregnation, which is fast and lasting.

Staining Cell-walls.†—M. J. Chalon communicates the results of the third series of experiments on staining cell-walls. The staining solutions used were magenta-red, anilin-blue, crocein, tropæolin, neutral red, alkaline blue, naphthylene-blue, congo-red, erythrosin, fuchsin, cyanin, and ruthenium-red. The double stains tried were alkaline blue and fuchsin, alkaline blue and eosin dissolved in oil of cloves, logwood and safranin, cyanin and congo-red, alkaline blue and safranin, solid green and delta purpurin, chrysoidin and azurin, cyanin and eosin, naphthylene-blue and acid-green, alum-methylen-blue and ruthenium-red, acid-green and neutral red. The results from alum-methylen-blue and ruthenium-red are described as superb. Methyl-green may be substituted for methylen-blue. The preparations are immersed for 5–10 minutes in aqueous alum-methylen-blue solution, washed in water, and then transferred to aqueous solution of ruthenium-red. Later on the author recommends alum-carmine and iodine-green, as giving the best differentiation and most lasting results. Other combinations recommended are alum-carmine and methylen-blue, prussian blue and safranin.

Fixation, Staining, and Structure of Protoplasm.‡ — Prof. A. Fischer's work on the fixation, staining, and structure of protoplasm is an exhaustive critical examination of the technique which has been adopted and pursued in modern cell research, and of the theories and speculations which have arisen in consequence of these researches.

The first part deals with fixation generally, that is to say, with the material to be fixed, fixing agents, the appearances produced by fixatives acting on albuminous bodies, and fixation of cell-contents.

The second part is devoted to staining, and the subject is discussed on lines similar to those of fixation. That is to say, there is consideration of the substances to be stained, and of the various pigments and staining fluids used in the process.

* Neurol. Centralbl., March 1899. See Zeitschr. f. angew. Mikr., v. (1899) p. 145.

† C.R. Bull. Soc. Roy. Bot. Belgique, 1898, xxxvii. (1899) pp. 59–90. Cf. this Journal, 1898, p. 685.

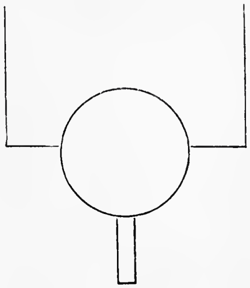
‡ Jena, Gustav Fischer, 1899, x. and 362 pp., 1 pl. and 21 figs.

In the third part the structure of protoplasm is treated of. Therein are discussed striation and artificial striation, the central body, the polymorphism and monomorphism of protoplasm.

(6) Miscellaneous.

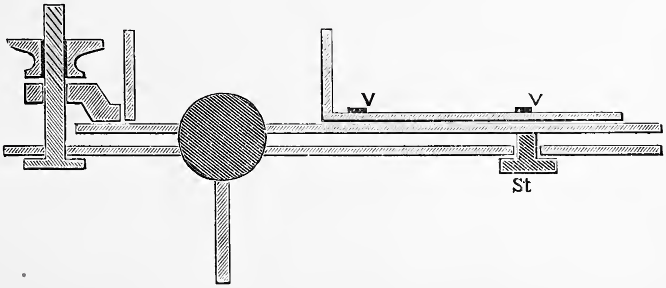
Jordan's New Apparatus for Orienting Small Microscopic Objects.*—Dr. Jordan's embryological researches at the Naples Zoological Station impressed upon him the desirability of endeavouring to find a means of solving the following problem :—" How to get objects

Fig. 138.



to orientate themselves and assume such a position that they can, without risk of displacement, be imbedded in paraffin." His apparatus, invented for this purpose, consists in principle of an orienting table within a trough, which finally, after the hardening of the imbedding material, allows the removal of the paraffin block with the object. A

Fig. 139.



small rectangular box, whose base is some 20 mm. in perimeter, is perforated with a circular aperture, in which a sphere so fits that slightly more than half of it projects into the box. The embryo or other object is placed upon this sphere, secured as described later, and oriented by means of the handle as desired (fig. 138). In a more complete form,

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 33–7 (2 figs.).

shown in section in fig. 139, the sphere works between two plates, of which the lower is in position for Zeiss' preparation Microscope, and the upper can be so pressed by a screw against the lower that the sphere becomes firmly fixed. A rectangular frame, whose walls are perpendicular to one another and to the horizon, is then applied.

The sphere is first smeared with a thin resinous layer and allowed to dry; the object, soaked in cedar-wood oil, is then applied, and secured with collodion. The orientation is now accomplished by aid of the Microscope, the sphere secured, the frame applied, and the paraffin poured in. If the sudden warming is objectionable, pieces of solid paraffin are inserted, and the whole is placed in the thermostat. After cooling, the block with the object is easily lifted off. In cases where it would be disadvantageous for the object to lie so close to the outside of the paraffin block, it is well to lay between the sphere and the object a bit of a larger embryo or some similar material saturated with paraffin and easy to cut.

Dr. Jordan states that he has obtained good results both in orientation and in sections (serial or single). He worked with embryos of 1 to 3 mm.

Fig. 140.

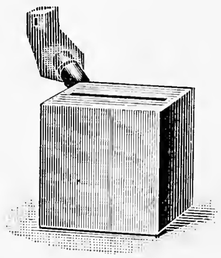


Fig. 141.

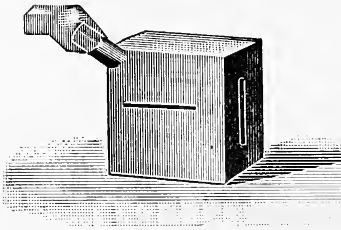
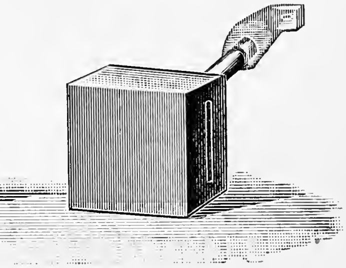


Fig. 142.



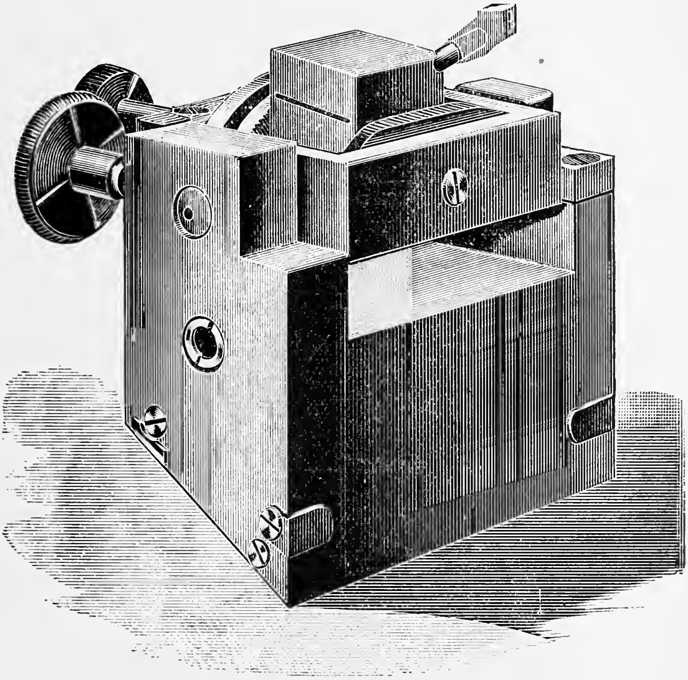
Method for Orienting Small Objects.*—Herr W. Noack describes the method used by him for orienting small objects in sectioning. A metal cube, the faces of which are 16 mm. long, is provided with an arm projecting from one angle in the direction of the diagonal of

* Zeitschr. f. wiss. Mikr., xv. (1899) pp. 438–43 (6 figs.).

the cube. Upon the end of this arm is fixed the celloidin block, in which the object is located so as to lie parallel to one of the faces of the cube. A few slices are removed from the block, and then the latter is examined to ascertain the exact position of the object. This done, a mark is scratched on the cube face in the direction of the central line of the object.

Owing to the direction of the arm, the object can be cut in any of three planes, transverse, sagittal, or frontal, or even in a combination of two, e. g. half in one direction, the remaining half in another.

Fig. 143.



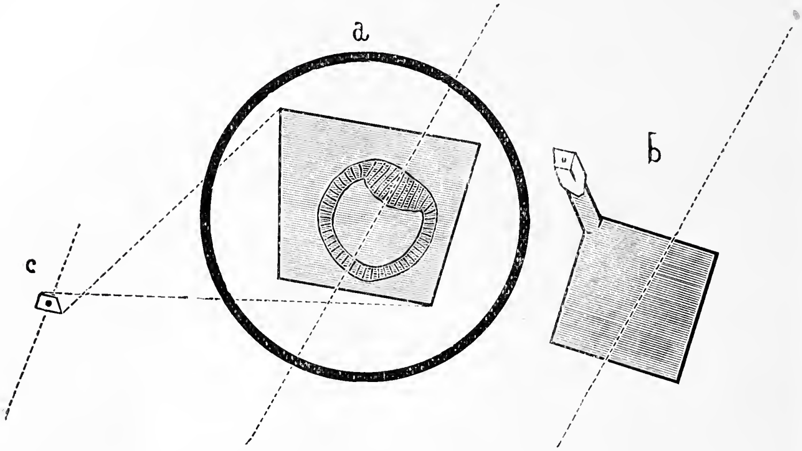
The idea of the apparatus is easily understood from the illustrations (figs. 140–145).

Lignin Reaction of Wood.*—Herr F. Czapek has succeeded in finding a suitable method for obtaining lignin, the isolation of which has long been a desideratum. Wood sawdust is boiled for some minutes in chloride of tin solution, and the chromogenic substance extracted with benzol or ether. A cold saturated solution of sodium bisulphite acts in a similar way to the tin chloride. The amount obtained from 1 kilo. of wood is extremely small. The new body is called *hadromal*, and, accord-

* Zeitschr. f. phys. Chemie, xxvii. (1899) pp. 141–66. See Bot. Centralbl., lxxix. (1899) pp. 126–8.

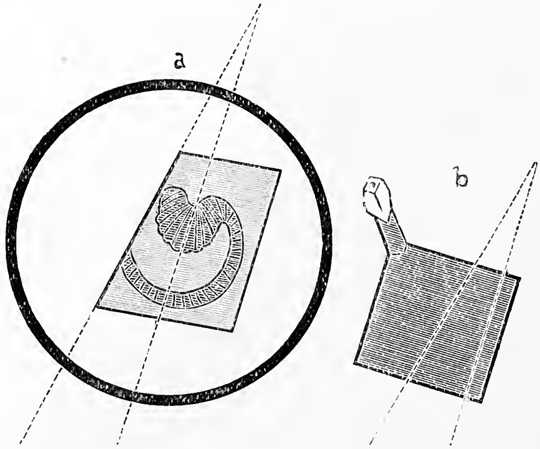
ing to the experience of the author, is constantly present in the most different kinds of wood. It is suggested that the hadromal is a 1, 3, or

FIG. 144.



4 substitution product of benzol, and that the constituent of woody membrane which causes the lignin reaction is a hadromal-cellulose-ether, together with a very small quantity of free hadromal.

FIG. 145.



Microchemical Test for Phosphorus.* — Dr. G. Pollacci had previously shown that the presence of phosphorus in vegetable tissue is microchemically demonstrable by means of a mixture of ammonium molybdate and nitric acid and an aqueous solution of chloride of tin

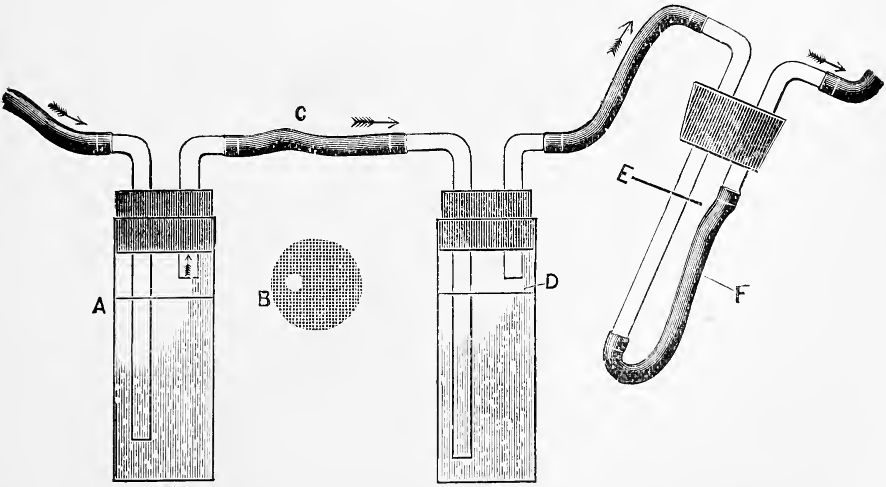
* Atti Ist. Bot. r. Univ. Pavia, vi. (1898) 8 pp., 1 pl. See Bot. Centralbl., lxxix. (1899) pp. 11–12. Cf. this Journal, 1895, p. 249.

($SnCl_2$). If the tissue contains the slightest trace of phosphorus, it becomes stained a cœrulean blue colour in consequence of the formation of ammonium phospho-molybdate, and of the reduction of this body with the formation of sesquioxide of molybdenum. Some botanists have raised objections to this test on the ground that the staining is due to xanthoproteic acid, or to an excess of molybdate, while others have expressed doubts as to the value of the method in testing for phosphorus in lecithins, nucleins, glycero-phosphates, &c. To these objections the author replies, and shows that,—(1) Xanthoproteic acid has no influence on the phosphorus reaction. (2) On account of the solubility of ammonium molybdate in water, and the insolubility of phospho-molybdate, the preparations can be perfectly freed from the former by washing. (3) The green or brown staining which often occurs with chloride of tin solution is to be ascribed to excess of the reagent. (4) Ammonium molybdate converts the phosphorus in all compounds into ammonium phospho-molybdate.

The above described method is therefore perfectly trustworthy for the microscopical demonstration of phosphorus in all organic tissues.

Ethereal Oils in Microscopical Technique.*—Mr. H. Jordan has found that some examples of oleum cajuputi viride and oleum cajuputi album dissolve celloidin. He has remarked that the solvent action is unusually frequent after Calleja's method for staining connective tissue. Oleum linaloes stands the test well.

FIG. 146.

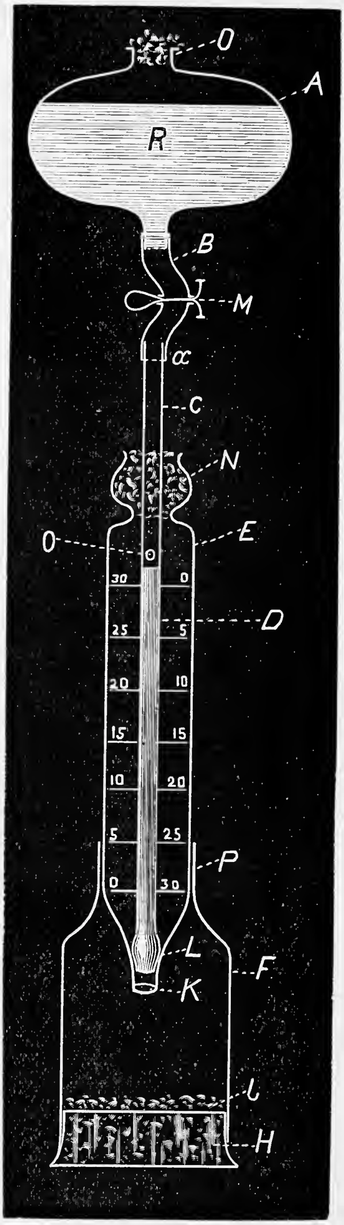


Convenient Washing Apparatus.†—Mr. E. M. Wilcox describes a washing apparatus which is especially adapted for laboratory use (fig. 146). It consists of a jar or a series of jars, each of which is closed with

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 46–7.

† Journ. Applied Microscopy, ii. (1899) p. 396 (1 fig.).

Fig. 147.



a rubber stopper perforated for an inlet and outlet tube. The former reaches nearly to the bottom, and the latter projects a short distance below the stopper. A piece of wire gauze or a perforated plate is inserted in the long tube just below the level of the outlet tube, to prevent escape of the material. As indicated in the illustration, any particular bottle can be removed from the series without interfering with the general arrangement.

Apparatus for Drawing off Sterile Fluids.*—Dr. Stanilaus Epstein has devised an apparatus (figs. 147, 148) for drawing off measured quantities of sterile fluid. The apparatus consists of a vessel R, which contains the sterile fluid, a graduated burette E, and a bell-jar F closed with a cork stopper H, upon which is placed a thin layer of cotton-wool. In the vessel R are two openings, the upper one being plugged with cotton-wool, while to the lower one is attached a rubber tube B to connect with the burette. The burette E is closed below at K, by means of the conical end L of the glass rod D. The glass rod consists of two parts,

FIG. 148.

the upper part C being really a hollow tube having a perforation at O; the lower part D is solid. The upper part of the burette is plugged with cotton-wool N; the lower part fits into the bell-jar at P. The second figure shows a cap for covering the upper opening O of the vessel R.

The apparatus is best sterilised in two parts. The vessel R and the tube are one piece; the rest of the apparatus is another. A pinchcock is put on the tube at M. To use the apparatus, the stopcock M is opened and the burette filled up to any mark. By raising the tube C, the conical end L is also raised and the burette emptied.

Removal of Air Bubbles and other Gases.†—Mr. E. W. Berger states that air-bubbles may be easily removed by immersing the objects for a few hours (2–24) in water which has been boiled.

Cement for Fastening Metal to Glass.‡—200 grm. of finely powdered litharge of silver and 100 grm. of dry white lead are well mixed and worked up to a pasty mass with boiled linseed oil and copal lac.

* Centralbl. Bakt. u. Par., 1te Abt., xxii. (1899) pp. 34–5 (2 figs.).
† Journ. Applied Microscopy, ii. (1899) p. 388.
‡ Zeitschr. f. angew. Mikr., iv. (1899) p. 333.

The metal surface is smeared with the cement and then pressed on the glass, the superfluous cement being removed with some suitable instrument. The cement dries very quickly and becomes very hard.

Blackening Finely Polished Brass.* — (1) Dip in copper-vitriol solution, allow to dry, and then immerse in solution of sodium sulphide: bright blue-black film of copper sulphide.

(2) Smear with thin solution of mercuric nitrate, then (after drying) with sodium sulphide solution, causing a bright black deposition of mercury sulphide.

(3) Gold chloride and metastannic acid dissolved hot, then applied to the metal.

Photographic Developer.†—Herr E. Merck states that pyrocatechin sublimatum is increasing in popularity as a developer, as it keeps well in solution, is simple and easily manipulated, and quickly produces pictures of great clearness and distinctness. The following solution is recommended as a developer:—water 1000 ccm.; crystallised sulphite of soda 25 ccm.; crystallised carbonate of soda 50 ccm.; pyrocatechin 10 ccm.

Tauxe's Photographic Paper.‡—Prof. J. Amann calls attention to a new paper made by Tauxe of Lausanne, which he has found to possess great advantages for scientific and especially for photomicrographic photography. The finest details of the negative are faithfully and vigorously reproduced. No special treatment is required for copying, toning, or fixing. The copies may be retouched, written on, or painted with ink, Indian ink, water- and oil-colours, without any trouble.

* Cent. Zeit. f. Opt. u. Mech., No. 6, 1899, p. 55.
† Zeitschr. f. angew. Mikr., v. (1899) p. 24.
‡ Zeitschr. f. wiss. Mikr., xv. (1899) p. 445.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

DECEMBER 1899.

TRANSACTIONS OF THE SOCIETY.

X.—*Report on the Recent Foraminifera of the Malay Archipelago, collected by Mr. A. Durrand, F.R.M.S.—Part VI.*

By Fortescue William Millett, F.R.M.S.

(*Read 18th October*, 1899.)

Plate VII.

Family TEXTULARIDÆ.

Sub-Family **Textularinæ.**

Textularia Defrance.

Textularia inconspicua Brady, plate VII. fig. 1.

T. inconspicua Brady, 1884, Chall. Rept., p. 357, pl. xlii. fig. 6.

This is a feeble hyaline isomorph of *T. conica*, and occurs in two forms, one of them having the sutures limbate. Brady notes its resemblance to a small trochoid Rotalian; the Malay specimens are associated with a minute hyaline *Discorbina*, to which they bear a considerable resemblance.

It occurs sparingly at a few Stations in both areas, but the speci-

EXPLANATION OF PLATE VII.

Fig. 1.—*Textularia inconspicua* Brady. × 90.
„ 2. „ „ var. *jugosa* Brady. × 90.
„ 3. „ *quadrilatera* Schwager. × 90.
„ 4. „ *rhomboidalis* sp. n. × 90.
„ 5. „ *concava* Karrer sp. × 60.
„ 6, 7. „ „ var. *heterostoma* Fornasini. Fig. 6 × 90. fig. 7 × 60.
„ 8. „ *sagittula* var. *jugosa* T. R. Jones. × 90.
„ 9. „ „ var. *fistulosa* Brady. × 90.
„ 10, 11. „ „ var. × 60.
„ 12. „ „ var. *Candeina* d'Orbigny. × 45.
„ 13.—*Bigenerina nodosaria* d'Orbigny. × 60.

a, Transverse section of the biserial portion of the test; *b*, oral aspect.

mens are sufficiently numerous to mark perfectly the transition from the normal to the limbate form.

Brady gives three 'Challenger' Stations, all in the Pacific, namely, off East Moncœur Island, Bass Straits; Nares Harbour, Admiralty Islands; and the *Hyalonema*-ground south of Japan.

Textularia inconspicua var. *jugosa* Brady, plate VII. fig. 2.

T. jugosa Brady, 1884, Chall. Rept., p. 358, pl. xlii. fig. 7.
T. jugosa (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 273, pl. vi. figs. 19–21.

"D'Orbigny has figured a specimen to all appearance belonging to this species (Foram. Canaries, pl. i. figs. 19–21) under the name of *Textularia sagittula*, and it is difficult to account for the apparent confusion of two forms so entirely distinct":—So wrote Brady (Chall. Rep., p. 358). In his 'Foraminifera of the Crag,' 1895, p. 145, Prof. T. Rupert Jones has no difficulty in associating as varieties of *T. sagittula* both d'Orbigny's and Brady's forms, and adds to them the heavy arenaceous limbate variety of *T. sagittula* found in the Crag and other deposits.

It is not stated by d'Orbigny nor by Brady if the shell-substance of their species is hyaline or arenaceous; the latter, however, remarks that the raised bands of *T. jugosa* are of clear shell-substance. From Raine Island ('Challenger' Station 185) I have some fine specimens of the last named form, and they are all distinctly hyaline, the limbations, moreover, being clearer than the other portions of the test. In Brady's figures, both of *T. inconspicua* and *T. jugosa*, there is shown a delicate striation of the margin of the oral face of the segments; this is conspicuous in all the specimens I have had an opportunity of examining; and in the large fossil specimens from Lucugnano figured by Costa * under the name of *T. sagittula* this feature is well shown.

Seeing that the relationship of *T. inconspicua* with *T. jugosa* is well indicated by the Malay specimens, and that the arenaceous form is also found in the same seas, it would appear convenient to treat the hyaline form as *T. inconspicua* var. *jugosa* Brady, and the arenaceous form as *T. sagittula* var. *jugosa* T. Rupert Jones. In the absence of a knowledge of the shell-substance of the limbate varieties of *T. sagittula* figured by Costa and by d'Orbigny, it is not clear to which of these varieties they should be assigned.

It is doubtful if the power possessed by certain forms of strengthening the secreted shell by the agglutination of extraneous particles of matter has any zoological value; that it has none as far as genera are concerned, is shown by such obsolete names as *Plecanium* and *Ataxophragmium*; but it appears to be of use in dealing with the characters

* Costa, Atti Accad. Pontaniana, vol. vii. fas. 2, 1856, p. 287, pl. xxiii. fig. 11.

of species and varieties, consequently it would not be wise to ignore it entirely.

Textularia jugosa was observed at only one 'Challenger' Station, off Raine Island, Torres Strait, but Brady quotes other localities where it has been found. The solitary 'Gazelle' Station is West Australia. In the Malay Archipelago it is more rare than the non-limbate form.

Textularia quadrilatera Schwager, plate VII. fig. 3.

T. quadrilatera Schwager, 1866, Novara-Exped., Geol. Theil, vol. ii. p. 253, pl. vii. fig. 10. *T. quadrilatera* (Schwager) Brady, 1884, Chall. Rept., p. 358, pl. xlii. figs. 8–12.

The group of *Textulariæ* with abnormal apertures and other features indicating an affinity with the *Bolivinæ* is well represented in Mr. Durrand's collection, and affords opportunities of comparison which should prove of value to Rhizopodists. Prof. T. Rupert Jones in his 'Catalogue of the Fossil Foraminifera in the collection of the British Museum, 1882,' assigns the *Textularia obsoleta* of Eley to the genus *Bolivina*, and it is very doubtful if this species can be distinguished from *T. quadrilatera.*

In the Malay Archipelago this distinctly hyaline form is very rare, and has been observed only at Station 30.

It is recorded from several 'Challenger' Stations, both in the Atlantic and in the Pacific. As a fossil it occurs in the Pliocene of Kar Nicobar, and in the tertiary beds of St. Erth, Cornwall. To the kindness of Prof. Yokoyama I am indebted for some fine specimens from the tertiary of Hane, Prov. Tosa, in the Island of Sitkoku, Japan.

Textularia rhomboidalis sp. n., plate VII. fig. 4.

Test cuneiform, quadrilateral; the peripheral oblique to the lateral faces, making the transverse section of the test rhomboidal; sides slightly concave, margins rounded and lobulate, sutures curved and deeply excavated. Aperture an arched slit. Shell-substance hyaline and coarsely perforate. Length, 0·34 mm.

The rhomboidal section and hyaline test will serve to distinguish this from any other species of *Textularia* A superficial resemblance to *Verneuilina spinulosa* may have caused it to be overlooked hitherto, as it is widely dispersed. It occurs at several of the Malay Stations in both areas. I have specimens from Raine Island ('Challenger' Station 185) and other localities in Torres Strait, and have examined fine examples from the Ægean Sea collected by C. H. Nevill, Esq.

Textularia concava Karrer sp., plate VII. fig. 5.

Plecanium concavum Karrer, 1868, Sitzungsb. k. Akad. Wiss. Wien, vol. lviii. Abth. I. p. 129, pl. i. fig. 3. *Textularia concava* (Karrer sp.) Brady, 1884, Chall. Rept., p 360, pl. xlii. figs. 13, 14, and pl. xliii. fig. 11. *Textularia* (?) *concava* (Reuss) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 271, pl. vi. figs. 3, 4.

The typical form is represented only by a few examples from Station 6. The shell substance is composed of very small grains of sand, and the surface is smooth and of a light buff colour. There is a slight tendency to limbation of the sutures, or to a slight overlapping of the chambers.

It is reported from several 'Challenger' Stations in the Atlantic and in the South Pacific. Egger's rather doubtful examples are from West Africa, Mauritius, and between New Amsterdam and Australia.

Textularia concava var. *heterostoma* Fornasini, pl. VII. figs. 6, 7.

Sagrina affinis Fornasini, 1883, Boll. Soc. Geol. Ital., vol. ii. p. 189, pl. ii. fig. 10. *Sagraina affinis* Fornasini, 1888, Boll. Soc. Geol. Ital., vol. vii. p. 45, pl. iii. fig. 1. *Textularia heterostoma* Fornasini, 1896, Mem. R. Accad. Sci. Istit. di Bologna, ser. 5, vol. vi. p. 4, pl. figs. 6, 12, 13.

This is one of the many interesting forms of *Textularia* from the Italian tertiaries described by Signor Fornasini. It differs from the type in the peripheral margin, which is less square, and also in the position of the aperture. In *T. concava* the aperture is a slit with a raised border situated at the inner margin of the terminal chamber and parallel to the suture. In *T. heterostomella* the aperture is similar in character, but varies in its position. In the Italian specimens it is usually remote from the suture and placed obliquely to it at various angles. In the Malay form it usually reaches to the suture and is perpendicular to it. In the Malay Archipelago this is one of the most abundant and widely distributed of the *Textulariæ*. It is more coarsely arenaceous than *T. concava*; and in one form (fig. 7) there is a considerable contortion of the test and a general resemblance to *T. crispata*.

The Italian specimens are from the pliocene of Ponticello di Savena, near Bologna.

Textularia sagittula Defrance.

"Polymorphum *sagittula*," Soldani, 1791, Testaceographiæ, vol. i. pt. 2, p. 120, pl. cxxxiii. fig. T. *Textularia sagittula* Defrance, 1824, Dict. Sci. Nat., vol. xxxii. p. 177; Atlas, Conch., pl. xiii. fig. 5. *T. sagittula* (Defrance) Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. (Sci.) p. 332, pl. xiii. figs. 15–17. *T. sagittula* (Defr.) Malagoli, 1887, Boll. Soc. Geol. Ital., vol. vi. p. 520, pl. xiii. fig. 1. *T. sagittula* (Defr.) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 219, pl. xlii. fig. 1. *T. sagittula* (Defr.) Fornasini, 1888, Boll. Soc. Geol. Ital., vol. vii. p. 46, pl. iii. figs. 2–4, *T. sagittula* (Defr.) Chapman, 1892, Journ. R. Micr. Soc., p. 328, pl. vi. fig. 16. *T. sagittula* (Defr.) Egger, 1893, Abhandl. k. bayer.

Akad. Wiss., Cl. II. vol. xviii. p. 271, pl. vi. figs. 8–10. *T. sagittula* (Defr.) Grzybowski, 1894, Rozprawy Wydz. Mat.-Przyr. Akad. Umiej. Krakowie, vol. xxix. p. 187, pl. i. fig. 4. *T. sagittula* (Defr.) Jones, 1895, Palæont. Soc., p. 142, pl. v. figs. 15, 16, 18. *T. sagittula* (Defr.) Burrows and Holland, 1897, Proc. Geol. Assoc., vol. xv. p. 31, pl. ii. fig. 10.

There is nothing in the Malay specimens of this well known and ubiquitous species to call for remark. It is found at several Stations, and shows the usual variations of form and structure.

Textularia sagittula var. *jugosa* T. R. Jones, plate VII. fig. 8.

T. sagittula (Defr.) Fornasini, 1887, Boll. Soc. Geol. Ital., vol. vi. p. 374, pl. ix. figs. 1, 2. *T. sagittula* (Defr.) var. *jugosa* (Brady) T. R. Jones, 1895, Palæont. Soc., p. 145, pl. v. fig. 19. *T. rugosa* (Reuss) var. *marginata* Silvestri, 1896, Mem. Pontif. Accad. Nuovi Lincei, vol. xii. p. 77, pl. ii. fig. 4.

This is the arenaceous form of *T. jugosa* before referred to. It has been found only at Station 13, and the specimens are neither numerous nor well developed. The only perfect example (the one figured) is short and triangular, but there are fragments which possess the characters of the forms figured by Fornasini and Prof. T. R. Jones.

It is a question if this arenaceous variety has previously been found recent; yet strangely enough, Prof. T. R. Jones, writing of the Crag specimen, remarks, "this is the first record of the variety in a fossil condition." * Fornasini's and Silvestri's examples are from the pliocene of Italy.

Textularia sagittula var. *fistulosa* Brady, plate VII. fig. 9.

T. sagittula var. *fistulosa* Brady, 1884, Chall. Rept., p. 362, pl. lxii. figs. 19–22. *T. fistulosa* (Brady) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 271, pl. vi. figs. 15, 16.

This variety is very rare, and has been observed only at Station 2.

Brady considers the fistulose condition to be the result of redundant growth, and states that it is principally met with in specimens from tropical or sub-tropical latitudes. The only 'Gazelle' Station is Mauritius.

Textularia sagittula var., plate VII. figs. 10–12.

This is another form of the *sagittula* group. Essentially the initial portion of the test is much flattened with a more or less acute margin, and is formed of a great number of short broad segments. So far the characters of the test are constant, but the later chambers have a tendency to expand and become inflated in various manners. Sometimes each individual segment expands without regard to its

* Palæont. Soc., 1895, p. 146.

neighbours, as shown in figs. 10, 11; at other times they combine to form a symmetrical inflation of the test, as in fig. 12. In the Malay specimens these variations are very numerous, and afford materials for bringing together figures by various authors, the affinities of which have hitherto been very doubtful.

Of the figures in which the inflation of individual chambers occurs, the following may be mentioned:—*T. globigera* Schwager, 1866, Novara-Exped., Geol. Theil, vol. ii. pl. vii. fig. 100; *T. sagittula* var. *Soldanii* Fornasini, 1883, Boll. Soc. Geol. Ital., vol. ii. pl. ii. fig. 2; *T. Soldanii* Fornasini, 1887, Boll. Soc. Geol. Ital., vol. vi. pl. ix. figs. 3, 4; *T. conica* Chapman, 1892, Journ. R. Micr. Soc., pl. vi. fig. 20; *T. agglutinans* forma *jugosa* Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. pl. vii. figs. 297–299; and *T. luculenta* Brady, 1884, Chall. Rept., p. 364. The inflation in the last-mentioned form is not represented in Brady's figures, but I have specimens from 'Challenger' Station 24 (off Culebra Island) in which it is well shown. This variety is represented by figs. 10, 11, plate VII.

The figured specimens of the other form in which the later segments combine to form a club-shaped test are:—*T. Candeina* d'Orbigny, 1839, Foram. Cuba, pl. i. figs. 25–27; *Plecanium acuminatum* Seguenza, 1880, Atti R. Accad. Lincei, ser. 3, vol. vi. pl. x. fig. 5; *T. fungiformis* Fornasini, 1887, Boll. Soc. Geol. Ital., vol. vi. pl. x. fig. 1, and 1896, Mem. R. Accad. Sci. Ist. Bologna, ser. 5, vol. vi. pl., 1–5; and *T. cordiformis* Terquem, 1883, Cinq. Mém. Foram. Oolithique, pl. xiv. fig. 5. The Malay form of this variety is represented by fig. 12, pl. VII.

The most numerous and regular, and therefore probably the most typical, form of this variety of *T. sagittula* closely resembles *T. aciculata* d'Orbigny in the shape and arrangement of the chambers forming the later portion of the test, but the margins are obtuse instead of being acute as in that species. This particular form is found at a considerable number of the Malay Stations; the inflated varieties are more rare and more local.

Textularia agglutinans d'Orbigny.

T. agglutinans d'Orbigny, 1839, Foram. Cuba, p. 144, pl. i. figs. 17, 18, 32. *T. agglutinans* (d'Orb.) Woodward and Thomas, 1885, Thirteenth Ann. Rept. Geol. Nat. Hist. Survey of Minnesota for 1884, p. 167, pl. iii. figs. 6. 7. *T. agglutinans* (d'Orb.) Vine, 1885, Proc. Yorkshire Geol. Polytech. Soc., n.s., vol. ix. p. 28, pl. ii. fig. 17. *T. agglutinans* (d'Orb.) Sherborn and Chapman, 1886, Journ. R. Micr. Soc., ser. 2, vol. vi. p. 742, pl. xiv. fig. 6. *T. agglutinans* (d'Orb.) Brady, Parker, and Jones, 1888, Trans. Zool. Soc., vol. xii. p. 219, pl. xli. figs. 17, 23, and pl. lii. figs. 2, 3. *T. agglutinans* (d'Orb.) Chapman, 1892, Journ. R. Micr. Soc., p. 329, pl. vi. fig. 21. *T. agglutinans* (d'Orb.) Woodward and Thomas, 1893, Final. Rept.

Geol. Nat. Hist. Survey of Minnesota, p. 30, pl. C, figs. 7, 8. *T. agglutinans* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 267, pl. vi. figs. 1, 2. *T. agglutinans* (d'Orb.) Goës, 1894, K. Svenska Vet.-Akad. Handl.. vol. xxv. p. 35, pl. vii. figs. 300–303. *T. agglutinans* (d'Orb.) T. R. Jones, 1895, Palæont. Soc., p. 147.

There is little to be said about this well-known species; the Malay specimens are not large, and are widely diffused throughout both areas.

Textularia gramen d'Orbigny.

T. gramen d'Orbigny, 1846, For. Foss. Vienne, p. 248, pl. xv. figs. 4–6. *T. gramen* (d'Orb.) Balkwill and Wright, 1885, Trans. R. Irish Acad., vol. xxviii. (Sci.) p. 332, pl. xiii. figs. 13, 14. *T. gramen* (d'Orb.) Terrigi, 1889, Mem. R. Accad. Lincei, ser. 4, vol. vi. p. 109, pl. v. fig. 1. *T. gramen* (d'Orb.) Haeusler, 1890, Abhandl. schweizer. Pal. Gesellschaft, vol. xvii. p. 71, pl. xi. figs. 26, 27, 37. *T. gramen* (d'Orb.) Fornasini, 1891, Foram. Plioc. del Ponticello di Savena, pl. ii. fig. 6. *T. gramen* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 272, pl. vi. figs. 24–26.

The specimens are numerous and widely dispersed, but few of them are characteristic; in the majority the earlier formed portion of the test resembles *sagittula*, the later portion *agglutinans*.

Textularia conica d'Orbigny.

T. conica d'Orbigny, 1839, Foram. Cuba, p. 143, pl. i. figs. 19, 20. *T. conica* (d'Orb.) Haeusler, 1890, Abhandl. schweizer. Pal. Gesellschaft, vol. xvii. p. 72, pl. xi. figs. 40–42; 45, 46. *T. conica* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 273, pl. vi. figs. 34–36. *T. calix* Grzybowski, 1895, Rozprawy Wydz. Mat.-Przyr. Akad. Umiej. Krakowie, vol. xxix. p. 287, pl. ix. fig. 17. *T. conica* (d'Orb.) T. R. Jones, 1895, Palæont. Soc., p. 152, pl. vii. fig. 24.

This species is well represented, the examples being numerous and widely distributed. The exterior of the test is arenaceous, and is rougher than is usual in this form. It is most abundant in Area 1.

Textularia trochus d'Orbigny.

T. trochus d'Orbigny, 1840, Mém. Soc. Géol. Fr., vol. iv. p. 45, pl. iv. figs. 25, 26. *T. trochus* (d'Orb.) Haeusler, 1890, Abhandl. schweizer. Pal. Gesell., vol. xvii. p. 72, pl. xi. figs. 43, 44. *T. trochus* (d'Orb.) Burrows, Sherborn, and Bailey, 1890, Journ. R. Micr. Soc., p. 553, pl. viii. fig. 14. *T. trochus* (d'Orb.) Egger, 1893, Abhandl. k. bayer. Akad. Wiss., Cl. II. vol. xviii. p. 273, pl. vi. figs. 37, 38. *T. trochus* (d'Orb.) T. R. Jones, 1895, Palæont. Soc., p. 150.

The specimens are numerous and fine, and all, without exception, have the limbate sutures common in the recent, but rarely found in the fossil examples. It is restricted to Stations 2 and 22.

Bigenerina d'Orbigny.

Bigenerina nodosaria d'Orbigny, plate VII. fig. 13.

B. nodosaria d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 261, pl. xi. figs. 9–12; Modèle No. 57. *B. nodosaria* (d'Orb.) Fornasini, 1887, Atti Soc. Nat. Modena (Rendic.) ser. 3, vol. iii. p. 108, pl. i. figs. 3, 4. *B. nodosaria* (d'Orb.) Haeusler, 1890, Abhandl. schweizer. Pal. Gesell., vol. xvii. p. 73, pl. xii. figs. 1–4. *B. nodosaria* (d'Orb.) Goës, 1894, K. Svenska Vet.-Akad. Handl., vol. xxv. p. 27, pl. vii. figs. 313–323; and *Clavulina textularioidea* p. 42, pl. viii. figs. 387–399. *B. agglutinans* (d'Orb.) Egger, 1895, Jahresber. XVI. naturhist. Ver. Passau, p. (8) pl. i. fig. 1. *Clavulina textularioidea* (Goës) Goës, 1896, Bull. Mus. Comp. Zool. Harvard Coll., vol. xxix. p. 37, pl. iv. figs. 26–38. *B. nodosaria* (d'Orb.) A. Silvestri, 1896, Mem. Pont. Accad. Nuovi Lincei, vol. xii. p. 81, pl. ii. figs. 5, 6.

The specimen figured possesses the characters of the species in an extreme degree; it is smoothly arenaceous, and in this form is very rare, having been noticed only at Station 10. Very common is the rough form equivalent to the *B. agglutinans* of D'Orbigny, which occurs at several Stations in both areas.

Clavulina textularioidea Goës seems to be nothing more than an aberrant form of this species.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, Etc.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Development of Olfactory Nerve.‡—Prof. W. A. Locy finds that in *Acanthias* two elements are joined in the olfactory nerve,—the dorsal median nerve, hitherto unrecognised, and the laterally placed main olfactory. The lateral bundles, though differentiated a little later than the mesial element, outstrip it and become the main olfactory. Both groups of fibres arise long before the lobe is developed.

The elongated slender connective between brain and bulb, which in the adult condition simulates a nerve, is a secondary formation gradually produced by modification of the lobe. The true nerve is the group of relatively short fila olfactoria terminating in the glomeruli of the bulb.

It is necessary to distinguish clearly between this true nerve and the tractus. "However close the superficial resemblance may be, there can be no homology between a hollow tractus derived from the lobe and a structure of similar appearance composed of fila olfactoria."

As far as is known a tractus is always developed in Selachii. In *Protopterus* and Amphibia there is none. In *Hatteria* and *Lacerta* a tractus is present; in *Anguis*, *Amphisbæna*, and *Typhlops* there is none; nor is there any in *Amia*. In Teleosts both conditions are found; thus there is a tractus in *Cyprinus* but none in *Lophius*.

The "accessory olfactory" described in this paper seems to have been noticed before, but never attended to. Till more is known about it, the less said in regard to its possible homology the better.

Development of Frog's Head.§—Herr H. K. Corning, in studying this, has directed his attention particularly to the sense-organs, nerves,

* 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, &c., 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 and Reproduction, and allied subjects.

‡ Anat. Anzeig., xvi. (1899) pp. 273–90 (14 figs.).

§ Morphol. Jahrb., xxvii. (1899) pp. 173–241 (2 pls.).

and head-mesoderm. Among his results the following may be noted. Sense-organs and nervous system arise either exclusively or almost wholly from the inner layer of the ectoderm, the *Nervenblatt* of Goette. The ganglia of the cranial nerves arise from a ganglionic ridge, continuous at a certain stage with that of the trunk, and originally derivable from the medullary plate. But while the latter is composed in part from elements of the *Deckschicht* and in part of elements of the *Nervenschicht*, the ganglionic ridge of the cerebral ganglia belongs wholly to the *Nervenschicht*. The ganglionic ridge gives origin to nervous tissue only. As to the head-mesoderm, it arises from an outgrowth of the wall of the archenteron up to the level of the ectodermic hypophysial rudiment. No head-cavities were discerned; the segmentation of the mesoderm is brought about by the formation of the gill-clefts.

Regeneration of Intestinal Epithelium in the Toad during Transformation.*—B. F. Kingsbury has studied this process, which resembles in many ways that which occurs in insects during metamorphosis. In the untransformed tadpole (of *Bufo lentiginosus americanus*), in which the legs are well developed, but before the arms have broken through, the intestine is lined by simple columnar epithelium. Connected with the epithelium and hanging down from it, or partially intercalated between the bases of the columnar cells, are clusters of three or four small cells with scanty protoplasm, which have been generally compared to the crypts of Lieberkühn in mammals. After the arms have been put forth, these cell-clusters have increased markedly in size, and karyokinetic figures are abundant in them. From these cell-clusters the new epithelium of the transformed toad is formed. At first they are simply solid balls of cells; soon, however, a lumen appears in the middle of the ball, and it becomes converted into a hollow sphere or flask whose wall is a single layer of columnar cells. The spheres grow, the side toward the old epithelium opens, the neighbouring crypts (spheres) meet one another and fuse, and in that manner a new continuous epithelium is formed. The whole epithelium degenerates and disintegrates, and is pushed into the lumen of the intestine, where it remains as a mass of debris. If the cell-clusters in Amphibians correspond to the crypts of Lieberkühn in Mammals, the above observations favour Bizzozero's theory of the mode of regeneration of intestinal epithelium, namely, that the crypts of Lieberkühn are the seats of the regenerative activity.

Share of the Ectoderm in forming Mesenchyme.†—Herr H. Lundborg has studied the development of the chondrocranium in dogfish, salmon, frog, *Siredon*, &c., and sides with those who conclude that the mesenchyme is helped in its work by formative elements. He maintains that in the lower Vertebrata the mesenchyme may gain elements from any germinal layer (ecto-, endo-, or mesoderm), and he therefore doubts whether the doctrine of the definite *Specificität* of tissues, which Rabl and others uphold, can really be justified.

* Trans. Amer. Micr. Soc., xx. (1899) pp. 45–8.
† Morphol. Jahrb., xxvii. (1899) pp. 242–62 (2 pls. and 6 figs.).

Remarkable Abnormality in Development of Hen's Egg.* — M. Étienne Rabaud describes the formation of blastoderms without further embryonic development. After four and eight days' incubation only blastoderms were formed. The endoderm had an entirely parablastic appearance, the mesoderm was simply a somatopleure, there was an excessive development of blood-vessels, and there was no notochord. The observer finds in the abnormalities support for three conclusions,—(*a*) that the endoderm is parablastic in origin; (*b*) that the vascular system has an endodermo-parablastic origin; and (*c*) that the notochord arises from the vitelline, not from the invaginated or gastrula endoderm.

Rôle of the Periblast in Teleosts.† — Prof. W. Reinhard found in a Teleost embryo with closed Kupffer's vesicle and completed entoblast, that there were two masses of large cells with large nuclei lying on each side of the embryo about the middle of its length. They resembled those cells which penetrate into Kupffer's vesicle and form the beginning of the entoblast. They differentiate into the periblast, and lie beneath the lateral plates; and they insinuate themselves into the splanchnopleure and somatopleure. It is probable that they serve mainly to form the blood.

Protoplasmic Phenomena in the Trout Ovum.‡ — Prof. W. His describes the fresh protoplasm as a viscid fluid easily drawn out into threads, and distinguishes a turbid granular morphoplasm from a transparent hyaloplasm. The further development advances, the more does the hyaloplasm increase and the granular plasm decrease.

The blastomeres show persistent amœboid movements; moreover, if an egg be opened during the later stages of segmentation, almost all the cells protrude finger-like processes, and after a short time retract them.

The morphoplasm of the blastomeres forms a fine framework studded with plasmosomes; internally it surrounds the nucleus, externally it shows a membranous limiting zone; the meshes are occupied by hyaloplasm. The great and rapid changes which may occur in the form and arrangement of the morphoplasmic framework suggest the probability that its connecting medium does not mix with the hyaloplasm. The latter is indifferent to the fixatives which precipitate albuminoids.

When the egg passes into water there is a concentration of the plasma into an almost uniform—isotypic—rounded elevation. As segmentation sets in, the isotypic character is lost.

The membranous boundaries of the blastomeres arise from a thickening and fusion of morphoplasmic strands. Nothing is known of the internal organisation of the hyaloplasm, and it may be that its functional rôle is secondary to that of the morphoplasm.

As the functional state changes, e.g. in amœboid movements or in divisions, the distribution of the morphoplasm and hyaloplasm changes. The hyaline protuberances of the amœboid cells are still surrounded by a membranous limiting layer, and are traversed by a very fine and sparse plasmic framework. The latter becomes denser, and the hyaline pro-

* Comptes Rendus, cxxix. (1899) pp. 167–8.
† Biol. Centralbl., xix. (1899) pp. 486–7.
‡ Abh. k. Sächs. Ges. Wiss. Leipzig, xxv. (1899) pp. 159–218 (3 pls. and 21 figs.).

tuberance becomes turbid. It is not necessary to assume an autonomic mobility of the hyaline substance in order to explain the origin of the hyaline protuberances; they are due to a relaxation of the limiting layer and the morphoplasmic framework.

During nuclear and cell-division the distribution of the hyaline substance and framework substance changes in very regular fashion. The limiting framework is loosened out, and the accumulation of a hyaline area traversed by a loose framework precedes the new nuclear formation.

The facts observed are in no way inconsistent with Engelmann's hypothesis that contraction-processes imply coagulation-processes.

Unfertilised trout ova may be kept alive for four weeks in running water, but some interesting changes occur.

In ova of rainbow-trout which had remained seventeen days unfertilised, His observed numerous small astrospheres with multipartite microcentra. No nuclei or chromosomes were any longer recognisable. The appearance of astrospheres and centrosomes independently of the sperm suggests the original presence of autonomic ovum-centra. No cells are formed, but a sort of syncytium—with degenerate chromosome development.

Nucleolus of Hedgehog Ovum.* — Dr. E. Wace Carlier describes the various phases of the nucleolus in the ovarian ovum of the hedgehog. When the nucleus seems to have attained its maximum size, the nucleolus may be bodily extruded into the cytoplasm, where it breaks down; but more frequently it is retained in the nucleus and undergoes vacuolation. He sides with those who regard the nucleolus as consisting almost entirely of effete material resulting from the cellular metabolism.

Amniotic Fluid.† — Dr. V. Kistiakowski adduces numerous facts which lead him to conclude that the amniotic fluid in the cow originates during the first period of the development of the fœtus by transudation from the blood-vessels of the placenta, and that in the second half of the developmental period it is formed from the excretory activity of the digestive organs of the fœtus.

Development of Vertebral Column of Reptiles.‡—Herr H. Männer has followed this from the origin of the sclerotome to the differentiation of the vertebræ in *Lacerta agilis*, *Anguis fragilis*, *Coronella lævis*, and *Tropidonotus natrix*. From the first the sclerotomes are sharply defined by the boundary of the primitive segment and by the vessels which lie between the protovertebræ. The intervertebral cleft extends at first only into the middle of the sclerotome, and the densest accumulation of cells is found in the lateral third.

In the second stage the intervertebral cleft extends from the muscle-plate to the perichordal layer, and divides the sclerotome into two equal portions.

A third stage is characterised by the intrusion of the muscle along the intervertebral cleft, and the modifications consequent on this.

* Proc. Scot. Micr. Soc., ii. No. iii. (1897–8) pp. 184–8.
† Physiol. Russe, i. (1899) pp. 155–66.
‡ Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 43–68 (4 pls.).

Männer calls this stage the new segmentation of the skeletogenous tissue. The history of the two sclerotome halves is then traced in the different forms studied.

Development of Bat.*—Herr O. van der Stricht publishes a preliminary note on his researches on the fixation of the egg in the uterus in *Vespertilio noctula*. As in the hedgehog, the first stage in fixation is the formation of a connection between the primitive outer layer (placental ectoblast or trophoblast) and the wall of the uterus. This is accompanied by a desquamation and absorption of the epithelium of the uterus at the area of fixation. In the second phase of fixation the trophoblast proliferates greatly in an area corresponding with the future placenta. At this stage it is possible to distinguish between the embryonic placental region and the extraembryonic placental region. The third stage is signalised by the disappearance of the sharp line of demarcation between maternal and fœtal tissues. This is due to the development of a mass of vascular epitheloid tissue which arises from the primitive outer layer and penetrates the uterine wall. During this stage the amniotic cavity appears, but it is not until the next stage that it becomes a distinct space separating the embryonic disc from the placental region. In this next stage the amniotic folds appear, being formed from the embryonic ectoblast and the adjacent mesoblast. The placental ectoblast (cytoblast) takes no part in their formation.

Segments of the Vertebrate Head.†—Dr. Charles Hill finds that in Teleostean and chick embryos at a very early stage the whole neural tube, including the brain, is distinctly segmented. In the chick the segmentation soon disappears in fore- and mid-brain, but persists for a longer period in the medulla. So transient is the primary segmentation of the anterior part of the brain, that the supervening secondary segmentation has previously been homologised with the persistent primary segments of the medulla. In the primary segmentation there are three divisions to the fore-brain, two to the mid-brain, and six in all to the hind-brain. Of these six, the first forms the cerebellum, and the remaining five represent the medulla. The Vertebrate head has, therefore, primarily eleven segments. The paper is a preliminary communication only, and is illustrated by some remarkable figures, which display the segmentation of the brain in living trout embryos.

Visceral Clefts of Echidna.‡—Herr Maurer has had an opportunity of examining Semon's sections of *Echidna* embryos, and publishes a preliminary account of his observations on the organs which originate from the visceral clefts. These organs fall into two sets:—First, those which exist also in forms with open gill-clefts (Fishes and larval Amphibians). These are the thyroid, thymus, and post-branchial bodies. Second, those which originate from the degenerating clefts, and therefore appear in Amphibians at the time of the metamorphosis. These are the epithelial bodies, best represented by the carotid gland. In *Echidna* there are four gill-clefts, of which the first three form for a time open clefts. The first becomes specially modified in connection

* Anat. Anzeig. (Ergänzungsheft), xvi. (1899) pp. 76–88 (7 figs.).
† Op. cit., xvi. (1899), pp. 353–69 (22 figs.).
‡ Tom. cit. (Ergänzungsheft), xvi. (1899) pp. 88–101 (10 figs.).

with the ear, and gives rise to no epithelial residue. The second gives rise to the carotid gland, but takes no part in the formation of the thymus. The third cleft gives rise to a large outgrowth which is the primordium of the whole thymus. From this cleft an epithelial body also originates. The fourth cleft gives rise to an epithelial body. The post-branchial bodies originate as median evaginations of the wall of the fourth cleft. The thyroid arises as a median unpaired evagination of the ventral floor of the gullet. In other mammals the thyroid arises from a fusion of such an unpaired primordium with the post-branchial bodies, but in *Echidna* the three structures remain distinct throughout life. Similarly in higher mammals the thymus has usually a more complex character arising in connection with two or more clefts. The author gives a series of diagrams to illustrate the relation of the conditions seen in *Echidna* to those found in the lower Vertebrates.

Histogenesis of the Mesenchyme.* — Herr A. Spuler has investigated the development of cartilage and of bone in Mammals, Amphibians, and Selachians. He finds that before the formation of the matrix the future cartilage is represented by branched cells whose branches are closely interlaced. Round the network so formed the matrix is secreted, and the interlacing fibrils separate from the cells, which constitute the capsular cells of the cartilage. In the formation of fibres the cells produce fine fibrillæ round their periphery; these fibrillæ separate from the parent cells, and become covered and largely concealed by the secretion of matrix. In the development of bone the author considers it as proved that the osteoblasts are united by protoplasmic processes to the osteoblast layer, to each other, and to the neighbouring connective-tissue cells. He believes that the cartilage cells are directly converted into bone-corpuscles. The matrix of the bone arises in connection with the processes both of the osteoblasts and of the connective-tissue cells with which the former are connected. After the formation of the fibrillar matrix, a lime-containing cement substance is added to it. The author believes that the latter originates from darkly tinged granules found in the osteoblasts and their prolongations.

Development of Lizard's Tongue.†—Dr. Franz Bayer gives a short summary of his observations on this subject in *Lacerta agilis.* The first indication of the *dorsum linguæ* is a proliferation of the epidermis in a median groove between the halves of the first visceral arch. Later this groove becomes a ridge, which is divided into first two and then three ridges separated by furrows. The tip of the outgrowth divides, and forms the future forked tip of the tongue. Of the muscles the hyoglossi appear early, and are to be regarded as branches of van Bemmelen's row of cells; they have no primary connection with the tongue. The lingual glands originate on the eighth day by an invagination of the epithelium.

Development of Spleen.‡—Dr. W. Tonkoff gives some account of the very diverse opinions held by embryologists as to the origin of this

* Anat. Anzeig. (Ergänzungsheft), xvi. (1899) pp. 13-6.
† Morphol. Jahrb., xxvii. (1899) pp. 712-6 (5 figs.).
‡ Anat. Anzeig., xvi. (1899) pp. 405-6.

organ, and briefly notes his own results in the case of birds. He finds that in the fifth day of incubation in duck embryos the primordium of the spleen can be seen as a cluster of mesoderm cells which lie in the left dorsal region of the mesentery, near the dorsal pancreas primordium. The cells have no connection with those of the future pancreas. The cœlomic epithelium is thickened in the neighbourhood of the splenic and pancreatic primordia, but takes no part in the formation of either organ.

Development of the Trout.*—MM. A. Swaen and A. Brachet have made a special study of the development of the organs derived from the mesoblast in the trout. The points to which they have directed their attention are, the segmentation of the mesoblast, the development of the vascular system and of the sclerotomes, and the origin and morphological significance of the pronephros. As to the pronephros, they find that, in its first beginnings, this organ arises by an isolation of the internal part of the splanchnocœle from the fourth somite to the cloaca. The cavity thus shut off becomes in the posterior region the pronephric duct, but more anteriorly forms the pronephric chamber. The pronephric duct is, therefore, a rudimentary pronephric chamber. The chief difference between the true pronephric chamber of the trout and that of *Ichthyophis* is the absence in the former of the *Aussentrichter* of the latter. According to the authors the pronephric chamber of Teleosteans is the homologue of the dorsal part of the cœlom in *Petromyzon* and Amphibians, and the degree of isolation of the cavity varies in the different Vertebrates according to the functional importance of the organ. In Teleosteans the pronephric duct exhibits in rudiment the parts of the pronephros, showing that the organ once extended throughout the greater part of the body. As to the bearing of these results upon Rückert's views as to the phylogeny of the pronephros, the authors believe that it is necessary to regard the pronephric chamber as an integral part of the primitive pronephros, this pronephric chamber being defined as that portion of the splanchnocœle into which the tubules open, and whose walls contain networks of blood-vessels derived from the aorta.

As to the other mesoblastic structures, the authors find that the elements from which the vascular system originates are distinct from the mesenchyme which gives rise to the connective-tissues and probably to the lymphatic system. The vascular system developes in two distinct areas of the embryo, the cardiac endothelium and the migratory vascular cells arising anteriorly, and the aorta, median vein, and formed elements of the blood posteriorly in the segmented region of the embryo. They do not believe that the cavities of the blood-vessels are cœlomic, but emphasise the distinctness in origin of lymphatic and blood-vascular systems. The blood-system is certainly mesoblastic in origin in Teleosteans, but they are unable to explain the reason of the distinction from Amphibians, where, according to several authors, the blood-system originates in the hypoblast.

Origin of Paired Fins in Selachians.†—Dr. Hermann Braus, as a part of his researches on the development of the musculature and peri-

* Arch. de Biol., xvi. (1899) pp. 173–311 (7 pls.).
† Morphol. Jahrb., xxvii. (1899) pp. 501–629 (4 pls. and 6 figs.).

pheral nervous system in Selachians, publishes an elaborate memoir on this subject. His general conclusions are as follows. During development the paired fins undergo very distinct changes of position, but these changes are by no means identical in all forms. Expressed in the most general form, it may be said that the oldest and best defined tendency is for the anterior fins to move towards the head, and the posterior towards the tail; but in certain families both tendencies may be reversed. In some cases, indeed, two opposite tendencies may be displayed at different periods in the development of the same individual. The development yields no proof of the lateral fold hypothesis or the concentration theory. In origin the muscle primordia show a very striking independence of the skeletal primordia, the metamerism of the one having no relation to that of the other. The author considers that this shows that the skeleton of the extremities must have quite another origin than their musculature. He believes that the suggestion which best fits the facts is that the skeleton of the paired limbs originated from the elements of the branchial skeleton (Gegenbaur). This would explain the discordance between the development of musculature and skeleton, and the change of position of the limbs during development which is most marked in the lowest fishes, and which occurs in a region of the body into which gill-arches must formerly have extended. The result of the research is, therefore, to add embryological confirmation to a hypothesis hitherto supported only by reasoning derived from comparative anatomy.

Development of Carapace in Chelonia.*—Herr A. Goette has investigated this point in *Chelone imbricata* and various other tortoises (*Podocnemis*, *Emydura*, *Clemmys*). He has studied especially the development of the costal and neural plates, in order to settle the vexed question as to their origin. He finds that in *Chelone* these bones contain no trace of a dermal element. The costal plates are greatly thickened periosteal ossifications of the cartilaginous ribs, together with an ossification in the atrophied dorsal muscles. The neural plates are also subcutaneous ossifications, partly periosteal and partly ligamentous in origin. Recently Gegenbaur has revived the old hypothesis of the origin of the carapace from a union of cutaneous and deep-seated elements, on account of the conditions which prevail in the Atheca. In these a series of dermal ossifications forms a mosaic quite distinct from the internal skeleton, and Gegenbaur supposes that in the Thecophora this dermal skeleton has fused so completely with the internal skeleton as to be apparently lost. Goette, on the other hand, believes that the Thecophora were originally furnished with a median dermal skeleton which they have lost. He considers that there is no evidence to support Gegenbaur's view of a fusion of such dermal elements with the neural and costal plates.

Albino Eggs of Amblystoma.†—Mr. H. W. Britcher describes the development of white eggs of *Amblystoma punctatum* L. As the embryos took form, and began to twitch their bodies when the jelly was disturbed, a slight greyish mottling of the sides of the body was seen, and this pigmentation slowly increased as the tadpoles grew. Forms about

* Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 407–34 (3 pls. and 3 figs.).
† Trans. Amer. Micr. Soc., xx. (1899) pp. 69–72 (1 pl.).

18 mm. in length could not be distinguished by the naked eye from normal embryos raised in dim light in the laboratory, but were a little lighter in colour than embryos freely exposed to the sunlight.

Maturation Phenomena in Amphibians.*—Herr R. Fick discusses the present position of the question as to the origin of the chromosomes of the first directive spindle. There is at present a reaction in favour of the old view that the strands of the chromatin figure originate from the nucleoli. The author's researches on frogs' eggs lead him to believe that the prevalent view as to the continuity and individuality of the chromosomes is untenable, and that during maturation there are several generations of nucleoli and chromatin figures. The nucleoli the author regards as nuclein laboratories in which the nuclein is in a resting condition as compared with the active state in which it occurs in the chromosomes, &c. Another much discussed maturation phenomenon is the movement of the germinal vesicle towards the animal pole at the beginning of segmentation. This movement the author ascribes to the active movement of the germinal vesicle, and not to differences in specific gravity producing a passive change of position.

Bilateral Symmetry of Frogs' Eggs.†—Herr O. Schultze has studied the eggs of *Rana fusca* in the very early stages of development, and finds that before the origin of the first segmentation groove the egg is distinctly bilaterally symmetrical. This symmetry is very distinct during the early stages of segmentation until the time of the formation of the blastopore. Externally this symmetry is indicated by colour differences, internally it is seen in sections to be indicated by a streak of pigment, and by the varying thickness of the roof of the segmentation cavity. The plane of symmetry corresponds to the median plane of the embryo (cf. Roux), and the first segmentation furrow arises along this primitive plane of symmetry. According to Roux there is a necessary connection between the position of the first segmentation furrow and the future median plane of symmetry of the embryo; but in *Rana*, though they are normally identical, the rule is not absolute. Perfectly normal embryos may originate from eggs in which the first cleavage furrow does not correspond with the plane of symmetry of the egg. The author also discusses various cases in other animals where the first cleavage furrow divides the egg into parts which do not correspond with the right and left halves of the future embryo, and then draws the following conclusions. In most cases the chief planes of symmetry of bilateral organisms are determined before gastrulation, and the blastomeres have definite relations to these planes. The bilateral symmetry of the egg appears at various periods in different embryos, and there is no proof of a universal "law of development" determining the relation of the median plane to the fertilisation plane or to the first cleavage plane.

Corpus Luteum of Mammals.—Dr. J. Sobotta‡ briefly discusses this much disputed question. He considers that none of the recent observations on the subject shake his original § conclusions, and that many recent statements are based on a confusion of atretic follicles and

* Anat. Anzeig. (Ergänzungsheft), xvi. (1899) pp. 68-72.
† Tom. cit., pp. 23-9. ‡ Tom. cit., pp. 32-4.
§ Cf. this Journal, 1896, p. 494.

corpora lutea. Further, the distinction between *corpora lutea vera* and *spuria* is entirely fictitious, the two being wholly similar structures. The *corpus luteum* originates from the *membrana folliculi interna*.

In the same place M. Honoré * details some observations on the same subject in the rabbit. In essentials his observations agree with those of Sobotta, but differ from them in some minor points. He finds that at the time of the rupture of the follicle the *membrana interna* is intact, and the yellow cells of the *corpus luteum* arise from the modified epithelial cells of this membrane. So far he is in perfect agreement with Sobotta; but, while the latter believes that the whole of the interstitial cells of the internal theca are converted into the connective-tissue elements of the *corpus luteum*, Honoré finds that a part only are so modified and a part persist for some days as little islands of cells between the *theca externa* and the yellow cells. The capillaries of the *corpus luteum* originate from the vessels of the old *theca interna*, in part by budding, and in part by giving off vaso-formative cells. The hæmorrhage at the rupture of the follicle is due to the tearing of the vessels of the internal theca.

H. Doesing † contributes the results of his study of the ovary of the sow. He finds that the epithelium of the follicle wall is disrupted, and plays no part in forming the *corpus luteum*. This arises from the modified elements of the *theca interna*, and is therefore entirely a connective-tissue structure.

Cell-division in the Mammalian Ovary.—Dr. Hans Rabl ‡ has investigated an ovary removed from an adult, which, like a previous preparation of Dr. Stoeckel's,§ seemed to show the formation of new ova in adult life. Stoeckel found multinucleated ova and also follicles containing several ova. He stated that the nuclei of the multinucleated ova arise by direct nuclear division, and that the follicles containing two or more ova become divided into two or more new follicles. Rabl's preparation was better fixed than that of Stoeckel, and enabled him to draw the following conclusions. He agrees with Stoeckel that the follicles with several eggs arise from the multinucleated eggs, that the follicles do not persist in this condition, but, by an ingrowth of the follicular epithelium become converted into several new follicles, and that in his own case and Stoeckel's this occurs in adult life. He disagrees however from Stoeckel in regard to the origin of the nuclei. He finds no proof that they are the result of direct nuclear division, but believes that the multinucleated eggs are eggs formed during fœtal life, which, owing to the pressure of the surrounding tissues, have been crushed together, and only separate in later life.

Fertilisation Phenomena in Lamprey.‖—Dr. Karl Herfort publishes a short account of his observations on the union of the pronuclei in the egg of *Petromyzon fluviatilis*. At the time when the union occurs, two rounded structures lie at the poles of the conjugating nuclei. Each consists of a darkly staining granule surrounded by an alveolar layer

* Anat. Anzeig. (Ergänzungsheft), xvi. (1899) pp. 34–8.
† Op. cit., xvi. (1899) pp. 299–301 (1 pl.).
‡ Arch. Mikr. Anat., liv. (1899) pp. 421–40 (1 pl. and 1 fig.).
§ Zeitschr. f. Geburtshülf. u. Gynäkol., xxxix.
‖ Anat. Anzeig., xvi. (1899) pp. 369–76 (5 figs.).

from which the protoplasmic threads radiate. The author believes that the rounded bodies are the periplasts or centrospheres of Vejdovsky, and the central granules his centrosomes. At the time of the formation of the first directive spindle the centrospheres enlarge enormously and become coarsely reticular, within them the centrosomes are indistinct. The observations seem to prove that the large rounded bodies of the directive spindles of Vertebrate eggs are not centrosomes in Boveri's sense, but centrospheres.

Spermatogenesis in Man.*—M. Sappin-Trouffy describes two modes of nuclear division in spermatogenesis:—(*a*) a multiplication of cells by the usual karyokinetic process; and (*b*) a direct nuclear division or fragmentation of the nucleus into four. The latter is interpreted as a particular mode of chromatin reduction.

Spermatogenesis in the Rat.†—Herr Ch. Regaud has attacked the problem of the origin of the spermatogonia in the mammalian testis. It is well known that the functional testis contains spermatogonia and the so-called "cells of Sertoli." The cycle of changes undergone by the spermatogonia has often been followed, but the question as to how the spermatogonia are renewed has received very insufficient attention. The author finds that in the rat the "cells of Sertoli" are really polymorphic nuclei imbedded in an undivided plasmodium. Their number remains nearly constant, but yet they increase by amitotic division. The resting spermatogonia consist of two main types. In the one the nuclei contain minute scattered granules of chromatin; in the other the chromatin is in the form of fibres; but complete series of transitional forms exist on the one hand between the nuclei of Sertoli and the nuclei with diffuse chromatin, and on the other between the latter and the nuclei with chromatin rods. Close observation shows that the different forms have the following relations. In the first period all the spermatogonia are transformed into spermatocytes. Then certain of the nuclei of Sertoli surround themselves with cytoplasm, and become converted first into spermatogonia with granular nuclei and then into those with nuclear fibres. When a certain number of spermatogonia have originated in this way, those of the second type begin to divide by mitotic division, and are ultimately transformed into spermatozoa. Thus the spermatogonia arise from the "cells of Sertoli"; and as the latter multiply only by amitotic division this form of division cannot be regarded as invariably an indication of degeneration.

Von Baer and Embryonic Variability.‡—Prof. Ernst Mehnert shows by quotations that K. E. von Baer fully recognised seventy-five years ago the fact of individual variation in embryonic development, and emphasised, furthermore, that the individual variations were physiological adjustments leading in the end to a normal embryo. He also maintained the position, recently reached by Fischel and Schwalbe, that the younger the embryos (of the chick) the greater are the individual differences. Mehnert complains of modern neglect of the older literature, and gives some illustrations of this.

* Comptes Rendus, cxxix. (1899) pp. 171–4.
† Anat. Anzeig. (Ergänzungsheft), xvi. (1899) pp. 42–57.
‡ Biol. Centralbl., xix. (1899) pp. 443–55.

b. Histology.

Researches on Structure.* — Prof. O. Bütschli in this volume describes his observations on the structure of protoplasm, of gelatin and similar colloids, and of starch-grains and crystalloids. His object is to show that in all these the minute structure is essentially similar—is the foam-structure so closely associated with his name. In many of the structures this is not directly apparent, but as the author believes can be manifested by the use of reagents. In many cases, and notably in the case of cell-walls and starch-grains, the results obtained are in striking variance with those of other observers on the same subjects.

Intestinal Epithelium.†—Herr M. Heidenhain contributes one of his careful histological studies, dealing in the present instance with the structure of the cells in intestinal epithelium. He shows that in the frog the plasmic fibres form very regular systems, the limits of which are often straight lines, and the symmetry of which is definitely bilateral. In short, he describes a marvellous architecture, the complexities of which far outrun the present possibilities of physiological interpretation.

Direct and Indirect Division.‡—Herr W. Rudnew has been led by his studies on the early development of a species of *Coregonus* to the conclusions:—(1) that direct division is a palingenetic phenomenon which in the genesis of the cell has preceded, as it may still precede, the occurrence of indirect division; and (2) that amitosis is often a quite normal phenomenon which may be followed by mitosis without any detriment to the organism.

Luminous Organs in Spinax niger.§—Herr L. Johann describes the minute structure of peculiar epithelial organs which are seen as brown or black spots on the skin of this fish. Each consists of 2–5 layers of 4–6 cells arranged in a circle, and the elements may be distinguished as luminous cells and lens cells. There is no special innervation apart from that of the skin as a whole. The primordium resembles that of a skin-gland. The luminosity was observed by Dr. Th. Beer.

Intestinal Secretion and Absorption.‖—Dr. W. Möller has studied this in numerous mammalian types. In all the forms investigated, except pig (?), dog, and cat, the Lieberkühn-crypts in the small intestine contain typical glandular cells. In these the secretion appears in the form of granules,—at first small and stainable, but gradually increasing in size and losing their stainable character. Finally, as in salivary glands and pancreas, the secretion is expelled in the form of drops into the lumina of the glands.

These glandular cells are quite distinct from the mucus-secreting cells. The latter are also well marked off from the adjacent epithelial cells.

From his investigation of the sheep's intestine the author concludes

* 'Untersuchungen über Structuren,' Leipzig, 1898, viii. and 410 pp., 99 figs., and Atlas of 27 plates. See Bot. Ztg., lvii. (1899) pp. 260–1.

† Arch. Mikr. Anat., liv. (1899) pp. 184–224 (2 pls.).

‡ Physiol. Russe, i. (1899) pp. 129–44 (16 figs.).

§ Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 136–60 (2 pls. and 1 fig.).

‖ Tom. cit., pp. 69–135 (2 pls.).

that the leucocytes seem to play a part in the ingestion and transport of part of the food (albuminoid material ?).

Multinucleate Epithelial Cells.*—Dr. W. Tonkoff finds that the multinucleate condition of the flat epithelial cells of the pericardium is of frequent occurrence in mammals and birds. It is probable that other serous envelopes will show the same. He notes, for the benefit of teachers of practical histology, that the pericardial epithelium of the adult cat is a readily available object for showing typical multinucleate cells, and that the same tissue in the white rat always shows good instances of direct nuclear division.

Innervation of Sensory Hairs.†—Herr P. Ksjunin has studied this in about half a score of mammals. There are nerve-endings which lie in the connective-tissue sheath of the hair-follicle, others in the external root-sheath, others in the papilla itself. The motor nerve-endings which are associated with the striped muscle of the hairs form a special (fourth) group. Perhaps the most marked result of the research is the demonstration of free intra-epithelial nerve-endings in the external root-sheath.

Envelopes of the Spinal Cord in Anura.‡—Dr. G. N. Sterzi has studied these in *Bufo viridis*, *Rana esculenta*, *R. temporaria*, and *Hyla arborea*. From within outwards, he describes the meninx secundaria, the dura mater, the "calcareous organ," and the endorhachis. The meninx secundaria and the dura mater correspond to the meninx primitiva of fishes, from which they are phylogenetically derived, and to the three envelopes in man. The "calcareous organ" is not an envelope, but the outer boundary of the epidural space. The epidural space corresponds to the same area in mammals, and to the intermediate layer in fishes; there is also an imperfectly developed subdural space which is absent in fishes. The endorhachis corresponds to the so-called *Rückgratkanalperiost* of mammals. In short, the condition in Anura is intermediate between that in fishes and that in mammals. The ontogeny corresponds exactly to the presumed phylogeny.

Stellate Cells of the Mammalian Liver.§—Dr. C. von Kupffer finds that these elements are not perivascular, but belong to the endothelium of the capillaries of the portal vein, which seems to form a syncytium with marked phagocytic properties. Foreign bodies and erythrocytes are taken up from the blood and disrupted into minute particles. It remains uncertain whether the leucocytes help.

Air-Sacs of Birds.‖—Mary J. Ross notes that the lining of the sacs (in the chicken) is pavement epithelium, except where the sac is attached to the surrounding tissue. Here there are variations in the form of the cells, which range from pavement to columnar epithelium. Cilia are present over the entire surface of the sacs contained within the body-cavity, but are absent from the prolongations of the sacs in the joints and in the cavities of the bones.

* Anat. Anzeig., xvi. (1899) pp. 256–60 (2 figs.).
† Arch. Mikr. Anat., liv. (1899) pp. 403–20 (2 pls.).
‡ Anat. Anzeig., xvi. (1899) pp. 230–9.
§ Arch. Mikr. Anat., liv. (1899) pp. 254–88 (3 pls.).
‖ Trans. Amer. Micr. Soc., xx. (1899) pp. 29–40 (3 pls.).

Thyroid and Thymus of Amphibians.*—Dr. H. Bolan has investigated the occurrence and structure of these organs in a large number of Amphibians. There may be one thyroid or several on each side, and the content consists either of colloid vesicles or of a connective-tissue meshwork with imbedded leucocytes and blood-vessels. There seems no regularity in their occurrence, for nearly related forms are often different. There is, however, never more than one colloid gland on one side. In Ecaudata the gland is always single, and it is colloid except in *Molge rusconii*. The author leaves the mutual relations of the two kinds of glands an open question.

In Ecaudata and Caudata the thymus is single on each side, except in the larval form of *Amblystoma tigrinum*, which has a variable number. In *Siphonops* there are four in a line. The content is a connective-tissue meshwork with leucocytes in the meshes, besides Hassal's corpuscles and sometimes fine capillaries.

Non-cellular Structures.†—Herr Boris Sukatschoff has studied the minute anatomy of such non-cellular structures as the cuticle in various animals, sponge-fibres, &c. Among the more important results are the following. The cuticle of *Lumbricus* in surface view showed the numerous pores of the skin-glands, and in optical section was seen to be composed of many layers. These layers are not fibrous, but have a fine foam structure. Chemically the cuticle consists of albuminoid substance. In *Aulastomum* and *Hirudo* the cuticle consists of a single layer, which careful examination shows to have a foam structure. Pores are present as in *Lumbricus*. In both *Hirudo* and *Aulastomum* the surface of the cuticle is marked by areas corresponding to the underlying cells. The same condition exists in the carapace of *Gammarus*, which is many-layered and exhibits irregularly arranged spaces (foam structure). A detailed study of old cocoons of *Nephelis* shows that the walls are formed from a foam-like coagulum of an originally soluble substance. The cocoon substance both in *Hirudo* and *Nephelis* gives the proteid reactions and is an albuminoid.

Structure of the Cell. — Prof. W. Flemming,‡ in his presidential address to the "Anatomische Gesellschaft," gives a general historical account of the observations made on the minute structure of the cell, from those of Frommann in the seventies until the present day. Frommann was the first to describe fibrillar structure both in living protoplasm and in stained preparations. Owing to imperfect methods and instruments, he fell into some errors which were corrected by Flemming at the beginning of the next decade. Almost at the same time Klein described a fibrillar structure which he called the cellular network, his description agreeing in essentials with that of Flemming. Heitzmann also described in different cells a fibrillar framework, but maintained that the interfibrillar substance is of purely fluid nature, and that the fibrils are identical in structure with the nuclear granules. Both these statements are strongly contested by Flemming. Passing over the observations of Van Beneden, Carnoy, and Leydig, which in essence

* Zool. Jahrb., xii. (1899) pp. 657–710 (11 figs.).
† Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 377–406 (3 pls. and 1 fig.).
‡ Anat. Anzeig. (Ergänzungsheft), xvi. (1899) pp. 2–12.

agree with those of Klein and Flemming, we come to Bütschli's foam theory. Flemming criticises severely Bütschli's methods, and believes that the greater part of his observations are based on material greatly modified by the reagents used, and that therefore most of his conclusions are unreliable. In cells where the protoplasm is clearly vacuolated, careful observation shows that the intermediate walls do not consist of homogeneous substance only, but of a mixture of this and fibrillæ. Flemming then touches lightly on Altmann's granule hypothesis, which he rejects, and on the views of Reinke and Waldeyer, which he regards as an attempt to reconcile the granular and the fibrillar theories. Flemming himself sees in the cell only the fibrillar framework and the interfibrillar substance, and is unable to further analyse either. The address was illustrated by preparations which are described.

Prof. His,* in a discussion of the paper, touches upon some points not treated of by Prof. Flemming. First as to the cell-periphery. The cell is surrounded by a peripheral layer of morphoplasm (fibrillar substance), and when this is absent the cells form a syncytium. His believes that the morphoplasm is the active substance, and the hyaloplasm a tenacious fluid.

Optic Chiasma of Amphibians.† — Herr Franz Fritz has applied modern histological methods to the study of this structure in various Anura and Urodela. He finds that the crossing is total, and where the nerves cross they break up into numerous small bundles of fibrils which form an interlacing basketwork. The same condition exists in Mammals, Ganoids, and Selachians. It does not occur in Teleosteans, and curiously enough is also absent in certain birds (e.g. the owl). This last fact is against the usual assertion that the Teleostean condition is primitive. Probably the two conditions have each their special significance, but what this is it seems impossible at present to explain.

Structure of Cerebellum.‡—Herr Alfred Shapfer has undertaken a series of investigations of the brains of different Vertebrates, in order to discover a means of defining the cerebellum, which displays so many structural differences in the different groups. He does not believe that the cerebellum can be regarded as a brain segment; it is rather an intersegmental structure originating as a parietal outgrowth of the neural tube. The difficulties of defining the limits of this outgrowth are great, but the author finds that in Selachians there is a distinct circular groove, which surrounds the inner wall of the neural tube in the neighbourhood of the primitive furrow between mid- and hind-brain. This groove seems to be constant throughout the Vertebrate phylum, and it marks the boundary between mid-brain and cerebellum. The result of the research is therefore to define the limits of the development of the cerebellar substance during embryonic life; in the higher Vertebrates the cerebellum undergoes many later changes, and comes into complex relations with the other regions of the brain. The author proposes the term *Sulcus meso-metencephalicus internus* for the circular groove.

* Tom. cit., pp. 41–2.
† Jen. Zeitschr. f. Naturwiss., xxxiii. (1899) pp. 191–262 (6 pls.).
‡ Anat. Anzeig. (Ergänzungsheft), xvi. (1899) pp. 102–15 (10 figs.).

Structure of Nerve-cells.—Dr. Emil Holmgren * has continued his observations on this subject, and finds that the intracellular vessels and nerves which he described in *Lophius* are also to be found in many other Vertebrates. In the cells of the spinal ganglia of rabbit, dog, and cat, he further finds that the cells of medium size show a wreath of canaliculi round the nucleus, with intra- and extra-canalicular zones. In the very large cells the canaliculi are more scattered and less regularly arranged. The canaliculi appear to be surrounded by special walls within the cells. In birds similar appearances were observed in the spinal ganglion cells, but the excentric position of the nucleus modifies the general relation of the parts. The canaliculi may be much branched and very numerous, so as to greatly reduce the amount of cell protoplasm. As well as the spinal ganglion cells in birds and mammals, cells from other parts of the nervous system also show intracellular canaliculi, but these were not found in fishes and Amphibians. The author considers the canaliculi to be of lymphatic nature.

The author also describes remarkable rod-like structures found especially in the cells of the sympathetic ganglia in birds and mammals. They seem to be identical with the structures called crystalloids by various observers, but Holmgren does not believe that they are of crystalloid nature.

Dr. F. R. Studnicka † states that he has also seen and studied the canaliculi and alveoli described by Holmgren. Studnicka has studied the structures in the cells of the nervous system of *Petromyzon planeri*, and points out the necessity of clearly distinguishing between the canaliculi and the intracellular capillaries of e.g. *Lophius*. He believes that the canaliculi originate from the fusion of vacuolar spaces in the cytoplasm, and as to their meaning, is inclined to lay great stress upon their connection with the pericellular lymph-spaces. A similar system of canaliculi ramifies in the axis cylinder of the large nerve-fibrils of the medullary cord of *Petromyzon*. Such canaliculi no doubt occur in the elements of the nervous system throughout the Vertebrate phylum.

Histology of Blood. ‡—Dr. Ermanno Giglio-Tos has studied the blood of the Ichthyopsida and the Sauropsida with special reference to the question of the nature, origin, function, and relations of the structures variously called spindle-cells, thrombocytes, blood-plates, &c. For these structures in the two groups named he prefers the term thrombocytes, reserving that of blood-plates for the structures found in mammalian blood. The method employed was to spread a drop of blood on a slide, and then dry rapidly in a flame. The dry blood is then covered by a drop of a saturated solution of BX methyl-blue in water. This is allowed to act for a minute only, and the blood is then washed with distilled water, and a cover-slip placed upon it. If the margin of the cover-slip is smeared with olive oil, the film of water does not evaporate, and the preparation will keep for four or five days. Various attempts were made to render the preparations permanent, but the simplicity of the method is such that it is better to make fresh mounts as they are wanted.

* Anat. Anzeig., xvi. (1899) pp. 388–97 (13 figs.).
† Tom. cit., pp. 397–401.
‡ Mem. Rea. Acad. Sci. Torino, xlviii. (1899) pp. 143–208 (2 pls.).

An examination of the blood of the frog and various other Vertebrates by this method showed that the thrombocytes in Ichthyopsida and Sauropsida are special morphological elements of the blood, and that they are homologous in the two groups. The blood-plates of mammals, on the other hand, exhibit a quite different structure, and are not homologous with thrombocytes. Thrombocytes display some resemblance to erythroblasts, but can be distinguished from these by the characters of their nuclei and cytoplasm, and by their physiological peculiarities. The thrombocytes never become converted into red corpuscles, and probably arise from leucocytes by a special process of evolution. Throughout their life they retain the centrosome. In reference to their blood, Vertebrates can be divided into three classes,—the Cyclostomes, which possess granular erythrocytes and thrombocytoid leucocytes, the Ichthyopsida and Sauropsida, which possess nucleated annular erythrocytes and thrombocytes, and the Mammalia, which possess annular non-nucleated erythrocytes and blood-plates.

Blood of Fishes.*—Herr Bernard Rawitz has applied Ehrlich's improved methods to the study of the blood-corpuscles of various fishes. He finds that in the case of fishes the blood should not be dried over a spirit-lamp, as in the case of mammals, but in a thermostat at a temperature of between 60° and 70°. The present paper is based upon results obtained from *Scyllium catulus*, but the author has also investigated various Ganoids and Teleosteans. He finds that Ehrlich's method gives much more complicated results in the case of fishes than in the case of mammals and Amphibians. In *Scyllium* the blood contains two kinds of erythrocyte, one kind oval and the other round; the latter arise in the blood from the former. Further, the change of shape is but a prelude to the degeneration of the corpuscle, which undergoes plasmolysis and karyolysis in the circulating blood. By the Ehrlich method it was found possible to distinguish no less than six varieties of leucocyte. But while there was no evidence that the erythrocytes undergo division in the blood, there is clear proof that many of the kinds of leucocyte originate in the blood stream. The circulating blood of the adult Selachian is therefore remarkable, because in it erythrocytes undergo degeneration and leucocytes multiply. The attempt to apply Ehrlich's granule method to the leucocytes yielded very contradictory results, inasmuch as both neutrophil and acidophil granulations occurred in the same form of leucocyte; and in the same preparation the granules of the same kind of leucocyte sometimes showed different reactions. This is in striking contrast to the constancy displayed by preparations of mammalian blood.

Structure of Herbert's Corpuscles.†—Prof. A. S. Dogiel has investigated the nerve-endings of the palate of the duck and goose. He finds that the cells covering the tunics of Herbert's corpuscles are not endothelial cells, but are homologous with flattened connective-tissue cells, and are furnished with branching processes. The axis-cylinder of the corpuscles consists of an axial fibre composed of many minute fibrils and a thick homogeneous peripheral sheath, which surrounds the fibre and

* Arch. Mikr. Anat., liv. (1899) pp. 481–513 (1 pl.).
† Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 358–76 (2 pls.).

fills up the spaces between its component fibrils. The axis-cylinder, after its entrance into the core of the corpuscle, gives off numerous small branching fibrils which end between the cells of the bulb and are furnished with a thin sheath of interfibrillar substance. Further, in addition to the thick axial fibre of the corpuscles, another slender fibre is present which also penetrates to the core of the corpuscle, and breaks up into numerous fine fibrils which surround the cells of the core.

Structure of Pacini's Corpuscles.*—Herr Guido Sala has studied these structures in the mesorectum of the cat, and has found corpuscles of the same peculiar structure as those described by Dogiel † in the palate of the goose and duck. In them the nerve-fibrils, immediately on their entrance into the core, break up into several branches which terminate in rounded swellings. In typical Pacini's corpuscles, further, the author finds an accessory nerve-fibril in addition to the main one. This observation seems to have been made independently of Dogiel's recent work.

c. General.

Origin of Life.‡—Herr Ludwig Zehnder attempts in this volume to explain the phenomena displayed by living organisms as the result of the peculiarities of their constituent atoms and molecules. The subject is treated wholly from the standpoint of the physicist. He conceives the living body as made up of molecules which constitute aggregates of different form. Of these, certain tubular structures (Fistellæ) are of supreme importance, and explain many phenomena of animal life. The apparent universal presence of a nucleus in cells the author explains by supposing that the nucleus as manifested in stained preparations need not necessarily pre-exist in living cells.

Chemistry of Life.§—Dr. Georg Hörmann adopts the idea of Pflüger that living matter consists of a giant molecule, and endeavours to show that the phenomena displayed, e.g. by muscles and nerves, are explained on the supposition that those structures consist, not of many molecules, but of atoms linked together into one huge molecule. The structure of the cell again he explains by the "principle of chemical continuity."

Inheritance of Longevity.||—Miss M. Beeton and Prof. K. Pearson point out that, whereas the theory of Wallace and Weismann interprets the duration of life in any organism as determined by natural selection, there has been no attempt to show whether duration of life is or is not inherited. This is obviously a previous question of the highest importance.

Their first statistical study is confined to the question of the inheritance of longevity in the male line, and the result has been to show that duration of life is really inherited. The figures seem to show

* Anat. Anzeig., xvi. (1899) pp. 193–6 (1 pl.).
† Arch. f. Anat. u. Phys. (Anat. Abt.), 1891.
‡ 'Die Entstehung des Lebens. Part I. Moneren, Zellen, Protisten,' Freiburg i. Br., 1899. See Bot. Ztg., lvii. (1899) pp. 257–9.
§ 'Die Continuität der Atomverkettung, ein Structurprinzip der lebendigen Substanz,' Jena, 1899. See Bot. Ztg., lvii. (1899) pp. 259–60.
|| Proc. Roy. Soc., lxv. (1899) pp. 290-305 (3 figs.).

that a substantial selective death-rate actually exists at work on mankind, and that, with like environment, it may amount to as much as four times the non-selective death-rate. In other words, natural selection is very sensibly effective among mankind.

Electric Phenomena associated with Motion in Animals and Plants.*—Sir J. Burdon-Sanderson discussed in the Croonian lecture the chemical, mechanical, and electrical concomitants of muscular motion, with a view to the elucidation of their mutual causal relations. "The lecture concluded with a comparison of the electromotive properties of the leaf of Venus's fly-trap (*Dionæa muscipula*) with those of muscle. If the same method of exploration is applied to the surface of the leaf as to the ventricle of the heart of the frog, it is easy to show that the phenomena observed after excitation in the two structures are essentially analogous. In both an electrical change is the immediate result of a localised instantaneous excitation, and this change spreads from the excited spot to parts at a distance at a rate which varies with temperature. The interval of time between the culmination of the electrical response and that of the change of form is much more obvious in the leaf than in the heart, because the mechanism by which it manifests itself works very slowly, as compared even with cardiac muscular fibres. This contrast, however, affords no ground for doubting that the two processes are, as regards their intimate nature, analogous."

Clamping Mechanisms in Animals.†—Dr. Otto Thilo has taken counsel with the engineers, and has made a most interesting study of those mechanical arrangements, mainly of the nature of clamps, which are found associated with the spines of fishes, e.g. *Monacanthus*, *Triacanthus*, and *Gasterosteus*. But he broadens his survey and interpretation to include such adaptations as the valves of the heart and the erection of the viper's fang.

Digestion in Dogfish.‡—Prof. E. Yung has made a study of the minute structure of the gut in *Scyllium*, as well as numerous physiological experiments on the digestive power of different regions. One main result stands out decisively, that the formation of pepsin is limited to a particular region of the saccular stomach.

A Reducing Animal Ferment.§—MM. E. Abelous and E. Gérard find that an extract of horse's kidney contains a soluble ferment which reduces nitrate of potassium and of ammonium, decolorises methylen-blue, and appears to form butyric aldehyde from butyric acid. They tried its effect on glucose, but without result.

Echidnase.‖—C. Phisalix has shown that the poisonous secretion of Viperidæ, e.g. *Vipera aspis*, contains a diastatic ferment (echidnase) in addition to the proper toxic substance. It varies in amount, according to the habitat and season. Thus there is more in the vipers of the Vendée than in those of Arbois; there is none detectable (in the secretion) in early spring, but plenty in summer. Experiments show that

* Nature, lx. (1899) pp. 343–6 (8 figs.).
† Biol. Centralbl., xix. (1899) pp. 504–17 (13 figs.).
‡ Arch. Zool. Expér., vii. (1899) pp. 121–201 (1 pl.).
§ Comptes Rendus, cxxix. (1899) pp. 164–6.
‖ Tom. cit., pp. 115–7.

this diastatic ferment is able to digest not only the tissues of inoculated animals, but the venomous principle or echidno-toxin itself.

Cellular Immunity.*—Messrs. L. Camus and E. Gley have shown that the hedgehog is naturally very resistant to the globulicidal properties of the ichthyotoxin of eel-serum. Not that there is any antiglobulicidal substance in the hedgehog's blood; experiments show that the resistance is localised in the red blood-corpuscles.

Other animals have this cellular immunity, viz. the frog, the toad, the hen, the pigeon, and the bat; their red blood-corpuscles resist the dissolving action of the ichthyotoxin.

It is a remarkable fact that, although the rabbit is very susceptible, the young rabbit, until it opens its eyes (fifteenth to twentieth day), is resistant.

An immunised doe-rabbit had young, and these were experimented with. Their red blood-corpuscles showed the habitual resistance, but at the same time their serum was found to contain antiglobulicidal substance. Here, then, congenital and acquired immunity coexisted in the same organism.

Vaccinal Immunity acquired by the Fœtus.†—Messrs. Béclère, Chambon, Ménard, and Coulomb have made observations on 65 women and 65 newly born children as to the intra-uterine transmission of vaccinal immunity, and an anti-virulent potency in the blood-serum. They have been led to the following conclusions:—

(1) Immunity, as regards vaccinal inoculation, has been observed only in those newly born children whose mothers were immune.

(2) The intra-uterine transmission of vaccinal immunity was not observed in the case of all the women who were immune at the time of accouchement, but only in a small number.

(3) The intra-uterine transmission of vaccinal immunity was observed only in those cases in which the blood, anti-virulent as regards vaccine, had transferred through the placenta its anti-virulent properties to the blood of the fœtus.

(4) The intra-uterine transmission of vaccinal immunity may be observed in mothers with anti-virulent serum who have been vaccinated during or before pregnancy, and even if the vaccination was in childhood.

(5) On the other hand, the intra-uterine transmission of the vaccinal immunity is not observed in mothers with non-antivirulent serum who were vaccinated before or during pregnancy.

(6) Therefore the passage of the anti-virulent substance from the maternal to the fœtal blood through the placenta is the necessary condition of congenital immunity.

(7) But this condition is not in itself sufficient; among newly born children whose serum is shown to be anti-virulent it may still be possible to inoculate with success.

(8) Among newly born children whose serum is shown to be anti-virulent there are variations in the degree of anti-virulent potency in the serum, and this is an important factor in the success or non-success of

* Comptes Rendus, cxxix. (1899) pp. 231-3. † Tom. cit., pp. 235-7.

vaccinal inoculations. The more anti-virulent the serum, the greater the presumption of failure in vaccinal inoculation.

Connection between Ear and Swim-bladder in Cobitis fossilis.*— Dr. J. Nusbaum and Herr S. Sidoriak have worked out this complex connection. They think it probable that the fish, which burrows in the mud, has acute hearing. Sound waves impinging on the thin regions over the lateral openings of the bony capsule of the swim-bladder may set up vibrations in the lymph surrounding the bladder itself. From the bladder the vibrations may be transmitted to the "mallei" and "stapedes," and thus be continued in the viscid fluid in the lymphatic spaces which communicate with the cavities enclosed between "stapedes" and "claustra." Finally, the vibrations in the lymph of the *cavum sinus imparis* may be transmitted to the upper wall of the *saccus endolymphaticus*, and to the endolymph of the entire membranous labyrinth, which is very richly provided with nerve-endings.

Distribution of Lizards.†—Dr. J. Palacký discusses this subject, which has as yet received very inadequate treatment in the text-books. The Sclater-Wallace geographical regions do not apply to lizards, and their distribution shows many striking peculiarities. The author gives the distribution of the families, and then describes in detail the Lacertilian fauna of the great continents and more important islands. The lists include both fossil and recent forms.

Lizard with Suctorial Tail.‡—Dr. Gustav Tornier describes the unique tail of *Lygodactylus picturatus* Ptrs., which, like the fingers and toes, bears attaching plaits. These form an effective sucker on the vacuum principle. There are twenty attaching plaits disposed in two rows, double the number that occurs on a toe or finger.

Origin of the Diaphragm.§—Herr F. Hochstetter has tackled the question, which has been repeatedly asked, whether the *diaphragma dorsale* of mammals is a new structure or is hinted at in lower Vertebrates. From his studies in lizards (*Lacerta*, *Stellio*, &c.) he concludes that one is justified in saying that the mammalian structure may be referred back to a rudimentary expression of it found in reptiles. The main differences depend on obliteration-processes in the pulmo-hepatic recessus. The diaphragm in bird-embryos, though with peculiarities of its own, may be referred back to the same origin.

Fresh-water Investigations.‖—Prof. H. B. Ward has made a very useful bibliography and summary of fresh-water investigations during the last five years, taking for his first date the publication of the first report of the Plön Biological Station and the opening of the laboratory on Lake St. Clair. It is a carefully executed piece of work, which will be of value not only in showing what has been done in the study of the problems of fresh-water faunas, but in indicating fruitful lines of future work. The bibliography occupies nearly fifty pages.

* Anat. Anzeig., xvi. (1899) pp. 209–23 (7 figs.).
† Zool. Jahrb., xii. (1899) pp. 247–85.
‡ Biol. Centralbl., xix. (1899) pp. 549–52 (3 pls.).
§ Morphol. Jahrb., xxvii. (1899) pp. 263–98 (1 pl. and 3 figs.).
‖ Trans. Amer. Micr. Soc., xx. (1899) pp. 261–336.

Fauna of the Swedish West Coast.*—Mr. C. W. S. Aurivillius has made a series of observations on the period of development of the invertebrates of the Skager Rack, and the periodicity in the appearance of larval forms in that region. His paper is illustrated by elaborate tables showing the date of appearance of larval and adult forms in the Skager Rack throughout the years 1893–8. The tables show not only the day of the month when the forms first appeared, but the depth at which they occurred, the temperature and salinity of the water, the condition of the tide, and the relative abundance of each form. The tables thus not only show the relation of the fauna to the physical conditions at the time, but also yield data from which may be calculated the period of sexual maturity for the different forms, and the rate of development. The general results of this elaborate piece of work are stated as follows. The fauna of the Skager Rack may be divided into two sets:—first, the animals which constitute the genuinely native forms (endogenetic animals), and second, those which invade the area from elsewhere, or at most are naturalised in it (allogenetic animals). The period of sexual maturity is in intimate connection with this division, that is, it depends upon the geographical nature of the forms. For the purely endogenetic forms the reproductive periods are chiefly influenced by the hydrographical conditions of the surface layers of water, and this whether the forms be bottom or plankton forms. Of the hydrographical conditions the temperature is the most important. As to the allogenetic forms, whether bottom or plankton forms, their increase depends upon the course of the currents which sweep the larvæ into the Skager Rack. Thus, for example, the northerly current which bears the waters of the Gulf Stream and flows from November to March, bears with it the characteristic Gulf Stream forms. Thus the periodicity in the appearance of larval forms in the Skager Rack depends upon similar causes both in endogenetic and allogenetic forms. In the first case it depends upon the fixed times for the appearance of sexual maturity; in the second upon the periodicity of the ocean currents which sweep in organisms from other parts of the ocean.

Plankton of the Oder.†—Herr C. Zimmer distinguishes (1) *eupotamic* plankton, consisting of organisms which flourish in flowing and still water, e.g. Rotifers; (2) *tychopotamic* plankton, consisting of organisms from pools and overflow basins, e.g. Entomostraca; and (3) *autopotamic* plankton, consisting (as far as known) only of Algæ. He discusses the differences in the fauna which are associated with differences in rate of flow, temperature, &c., of the river.

Tunicata.

Coloration of Tunicates‡—M. Antoine Pizon finds that most of the coloured spots and lines which occur on many Tunicates are due to pigment-granules, generally of very minute size (about 1 μ in circumference), and that these granules in the living animal show very rapid movements within the vesicles which enclose them. In *Botryllus smaragdus*, for instance, there are three kinds of coloured elements or

* Bihang t. Kongl. Svenska Vetens. Akad., xxiv. (1899) pp. 45–91.
† Preisschrift Philos. Facultät Univ. Breslau, Breslau, 8vo, 14 pp. See Zool. Centralbl., vi. (1899) p. 739.
‡ Comptes Rendus, cxxix. (1899) pp. 395–8.

chromocytes containing pigment-granules, and as their combinations vary, different colours are observable at different times. In *B. violaceus* there are the same three kinds as in *B. smaragdus*, but in different proportions. It is evident that varieties must not be based on differences of coloration. The author does not feel inclined at present to admit that the movements of the granules are nothing but Brownian movements.

Alleged Otocysts of Salpidæ.*—Mr. M. M. Metcalf calls attention to a blemish in the 'Traité de Zoologie concrète,' by Delage and Hérouard, a work for which at the same time he has the highest appreciation. In 1893 Metcalf showed that the so-called otocysts of *Salpa* are really glandular organs very possibly related to the neural gland of some of the Ascidians. Delage and Hérouard have accepted this observation, but suggest that the small (accessory) eyes in the ganglion of *Salpa* may be regarded as otocysts. But the cells of which these structures are composed are rod-cells exactly like the rod-cells of the larger eye, except in size; they have no resemblance to the setigerous cells of an otocyst; there is no cavity near them in which an otolith could lie. The idea that *Salpa* has ears is a zoological myth; for there is no trace of any structure which could be interpreted as an ear, in the region of the brain, in any of the eleven species of Salpidæ which Metcalf has studied.

Regeneration and the Germ-layer Theory.†—Dr. L. S. Schultze has studied the regeneration of the ganglion of *Ciona intestinalis*, and makes this a text for a general discussion of regenerative phenomena. In this particular research an interesting point in technique was observed. In order to kill the animals in the expanded condition, chrom-acetic acid was added drop by drop to the sea-water in which they were living. It was found that animals paralysed by this treatment could be revived by removal to clean water, and therefore the reagent was used before operating as an anæsthetic. In this way the ganglion could be removed with much greater ease than in active animals displaying the usual contractility. After the operation the animals were allowed to recover in clean water. The experiments showed that the ganglion and adjacent structures are completely regenerated. This is accomplished by the peribranchial epithelium, and as this is an ectodermal structure, the new ganglion arises from the same layer as that which during embryonic development produced the old one.

In his general discussion of regeneration, the author suggests the following definition of a germ-layer :—The germ-layers are complexes characterised alike by the organs to which they respectively give rise, and by the fact that they respectively occupy definite positions in the Metazoan embryo. They are formed of embryonic cells originating directly in the segmentation of the ovum. This definition readily covers ectoderm and endoderm ; but the conception of mesoderm can only be purely topographical. The conception of germ-layer should be limited to the embryonic cells arising from the segmentation of the ovum, and the layers in budding and regeneration may be designated by the terms

* Anat. Anzeig., xvi. (1899) pp. 301–2.
† Jen. Zeitschr. f. Naturwiss., xxxiii. (1899) pp. 263–344 (2 pls.).

ectolemma, mesolemma, endolemma. All the varied developmental conditions which control embryogenesis are strikingly different from those which obtain during asexual reproduction; so that the primary embryogenetic processes should be clearly distinguished from the secondary ones which prevail during asexual reproduction and regeneration. Further, a difference in the origin of the formative cells of an organ during embryological development on the one hand, and budding or regeneration on the other, does not in any degree vitiate the theory of the homology of the germ-layers, or the correlated homology of organs. The independence of the two processes is to be explained on "mechanical" grounds, and the germ-layer doctrine is to be regarded as a deduction from the observed fact that homologous organs always originate in the embryo from cell-layers having the same relative position in the two-layered embryo.

INVERTEBRATA.

Fauna of Frog Spawn.*—Herr C. Thon gives an interesting account of the animals which he found in ponds in Bohemia associated with the spawn of *Rana fusca* and *R. esculenta*. In two different localities the fauna was almost identical.

During the first days the spawn remained without associated animals. When the spheres of jelly had swollen up, and some of the brood had begun to take form, guests appeared. First he observed small Dyticidæ:—*Hydroporus halensis*, *H. pictus*, *Haliplus fulvus*, *Rhantus notatus*, which were not seen to injure the eggs. For a time before hatching there were some water-mites about, *Eylais setosa* Koenike and *Hydryphantes ruber* De Geer or *H. dispar* v. Schaub. As the jelly became softer, Copepods appeared, e.g. *Cyclops languidus* Sars and *C. fimbriatus* Fisch., and rarely a few Cladocera (*Chydorus sphæricus*, &c.). Ostracods seemed to help to loosen the jelly, e.g. *Cyclocypris lævis* and some young forms of *Cypris reticulata*. After hatching, there were many larvæ of *Cloëon dipterum*, *Ceratopogon*, *Chironomus*, *Limnophilus*, &c., and many of the insect larvæ devoured the young tadpoles. Beneath the spawn there was *Asellus aquaticus*. Nymphs of *Curvipes fuscatus* and *C. conglobatus* were also common. Among the tadpoles there were individuals of *Polycelis nigra*. When the empty spheres sank to the bottom, they were associated with encysted Vorticellids, numerous monads and diatoms, some statoblasts and ephippia, but no Infusorians or Rotifers.

Mollusca.

γ. Gastropoda.

Agglutinative Action of Snail's Albumen Gland.†—L. Camus finds that solution or extract of the snail's albumen gland contains an "agglutinin" which agglutinates diverse substances, such as blood-corpuscles and milk-globules. It is possible therefore that the substance of the gland may have some agglutinative rôle in reproduction.

Function of Gastric Gland in Snail.‡—W. Biedermann and P. Moritz describe the three kinds of cell in this gland,—(*a*) secretory cells,

* Verh. Zool.-bot. Ges. Wien, xlix. (1899) pp. 391–3.
† Comptes Rendus, cxxix. (1899) pp. 233–4.
‡ Arch. f. Physiol., lxxv. (1899) pp. 1–86. See Zool. Centralbl., vi. (1899) pp. 675–6.

whose secretion digests starch and cellulose; (*b*) absorptive cells; and (*c*) lime-cells. In the absorptive cells and lime-cells glycogen is stored, and fat, and perhaps some albuminoids. The lime-cells have especially to do with fat-storage, and they also contain calcium phosphate. The fresh secretion has no appreciable effect on albuminoids.

No food is absorbed in the intestine, which is lined by ciliated and glandular cells. From the stomach the fluid food passes into the gastric gland, whence some of it passes back in altered form.

Anatomy of Neritina fluviatilis.* — Dr. Lenssen points out the difference of opinion which exists in text-books as to the characters of the nervous system in this mollusc. He has studied it by the method of sections, and finds that *Neritina* belongs to the Chiastoneura, but displays either an initial or a regressive form of this condition. As to the heart, Lenssen finds that one auricle only is present. The nephridium has the ordinary structure. It consists of a tube bent on itself, and thus forming two chambers. Of these the upper has greatly folded walls, and opens by a ciliated nephrostome into the pericardium, while the lower has smooth walls, and opens into the branchial cavity. The rectum passes through the ventricle.

Development of Paludina vivipara.† — Herr C. Tönniges has repeated his former observations on this subject, and finds that his renewed research confirms his previous assertion that the mesoderm originates, not from primitive mesoblasts or cœlom sacs, but by the migration of ectoderm cells on the ventral surface of the embryo. In the cell-masses formed by the proliferation of the ectoderm cavities appear, which form the cœlom or pericardium. On the ventral wall of this primitively double cavity two thickenings appear, which are the primordia of the nephridia. Of these the left aborts. The originally paired ureter arises as an outgrowth of the mantle-cavity. The heart arises from a folding of the dorsal wall of the pericardium; the blood-vessels as spaces in the mesenchyme. The mesenchyme, like the mesoblast, arises from ectoderm cells, so that in *Paludina* all the cells lying between ectoderm and endoderm originate from the former.

Development of Chiton.‡—Mr. Harold Heath publishes an elaborate paper on the natural history, breeding habits, and development of *Ischnochiton magdalenensis*, and adds to his paper a discussion of cell-homologies between Annelids and Mollusca, and of the primitive form and relations of the trochophore. The Chiton studied is remarkable in laying its eggs in jelly masses instead of singly, the egg-strings having an average length of 31 inches, with an average content of 115,940 eggs. The larvæ begin to rotate in their egg-membranes at the end of 24 hours; six days later they begin their brief free-swimming existence, and after at the most a couple of hours, settle down on rocks and seaweeds, and undergo a gradual process of metamorphosis. The cleavage is total and nearly equal; the early cleavages conform to the radial type, and traces of radial symmetry persist until the close of the free-swimming life.

* Anat. Anzeig., xvi. (1899) pp. 401–4.
† S.B. Ges. Naturwiss. Marburg, 1899, pp. 1–10. See Zool. Centralbl., vi. (1899) pp. 702–5.
‡ Zool. Jahrb. (Abt. Anat.), xii. (1899) pp. 567–656 (5 pls. and 5 figs.).

Gastrulation takes place by invagination. In the development of the prototroch the egg shows a relation both to Annelids and to Gastropods. By a detailed comparison with the cells of the Annelid egg, the author endeavours to show that the head of the Annelid corresponds to that part of the Chiton which constitutes the proboscis, the first valve of the shell, and the mantle-furrow with the eyes. Further, the distinct traces of radial symmetry in the embryo lead him to the conclusion that the ancestral trochophore was a quadrilaterally symmetrical organism whose principal axis corresponded to that of the gastrula, and that the shifting of this axis is secondary. The radial cleavage of the egg is due to the influence of the radial symmetry of the ancestral trochophore. The resemblances between Annelid and Chiton trochophores are such as to make it impossible to doubt that they are derived from a common ancestor.

δ. Lamellibranchiata.

Contributions to our Knowledge of the Protobranchia.* — Dr. G. A. Drew has studied *Yoldia limatula* Say, *Nucula delphinodonta* Mighels, and *Nucula proxima* Say, all found along the coast of Maine. A brief statement of the chief points may be cited.

The mantle of *Y. limatula* has two pairs of sense-organs, an unpaired siphonal tentacle, and a fringe of marginal tentacles, all sensitive to mechanical stimulation. The foot is highly modified for burrowing; the palp-appendages are very active in collecting food; the gills of *Yoldia* are used for pumping water, and those of *Nucula* may function in the same way to a less extent. The genital ducts join the outer and not the inner ends of the excretory organs. The otocysts of *Y. limatula* are not connected with the surface by canals, for these seem to degenerate in the adults.

As to embryology, the embryos of *N. delphinodonta* are carried for many days in mucus-like cases attached to the posterior ends of the shells. The original surface cells seem to give rise to the tests, the cerebral ganglia, the apical plates, and to new ectoderm inside of the tests. The cerebral ganglia of *Y. limatula* are formed as invaginations from the surface. The otocysts of *Y. limatula* contain otoliths before the tests are cast. The test, at least part of the apical plate, and the stomodæum to the position of the definitive mouth, are all cast away. It seems that typical molluscan larvæ may have been developed from ancestors resembling the embryos of *Yoldia* and *Nucula* in form and structure.

Swiss Fresh-water Molluscs.†—M. Georg Surbeck has made a study of the molluscan fauna of the Lake of Lucerne, which includes 22 littoral forms, and one in deep water (*Pisidium clessini*). Compared with that of other Swiss lakes, the molluscan fauna here is poor, and shows no local characteristics of moment; it is most like that of the Lake of Constance and of some upper Bavarian lakes. Differences in size, shell-thickness, and abundance are noteworthy at different parts of the lake; they seem, for the most part, to be due to the environmental differences.

* Anat. Anzeig., xv. (1899) pp. 493–519 (21 figs.). See also Mem. Biol. Lab. Johns Hopkins, iv. (1899) No. 3.

† Rev. Suisse Zool., vi. (1899) pp. 429–556 (2 pls. and map).

Arthropoda.

Regeneration in Arthropods.* — M. Edmond Bordage notes that the re-growth of appendages takes place in a spiral in Phasmidæ and Blattidæ (Bordage, Brindley), in shore-crabs and hermit-crabs (Goodsir), and in spiders. In the lobster it is rectilinear as regards the limbs, but spiral in the antennæ until the first moult after mutilation. The difference is believed to depend on whether the rudiment of the regenerating appendage is flaccid or turgid from the commencement of its new formation. In Phasmidæ a limb regenerated after autotomy grows spirally, but after artificial section the regeneration is rectilinear.

Arthropods from Chili.† — Dr. Filippo Silvestri records the discovery of *Koenenia mirabilis* from Valparaiso. This Arachnid has previously been recorded only from the region round the Mediterranean, but the author considers that it is indigenous and not naturalised in Chili. In the same locality he found not a few other European Arthropods, such as *Campodea staphylinus*, *Pauropus huxleyi*, &c. The paper includes a description of *Peripatoides blainvillei* (Blanchard). This species is undoubtedly not a member of the genus *Peripatus* s. str., and it is remarkable that a form from Southern Chili should belong to the Australian genus *Peripatoides*, while the type genus is common in Central America, Ecuador, and as far as Bolivia.

a. Insecta.

Mosquitos and Malaria.‡ — Prof. B. Grassi has been communicating note after note on the rôle of mosquitos in spreading malaria, and in the paper before us by Grassi, A. Bignami, and G. Bastianelli, it is stated that all the species of *Anopheles* with which they have experimented have shown themselves capable of propagating malaria. The only Italian species in regard to which this has not been shown is *A. pseudopictus*, of which, and of *Culex*, &c., we shall doubtless soon hear more.

Larval Stage of Hypoderma bovis.§ — P. Koorevaar discusses the occurrence of the larvæ in the spinal canal and in the wall of the œsophagus, and the difficulty of coming to a clear understanding of the migrations within the body of the ox. Some which were introduced under the skin of a dog wandered about into various places agreeing with those in which they are found in cattle. This discovery, taken in connection with the fact that the introduction of the larvæ *per os* had no result, leads the author to the opinion that the young larvæ of *Hypoderma bovis* at first pass beneath the skin, and then betake themselves to the spinal canal and other places to return later into the subcutis, where they undergo further development under well-known conditions.

Female Genital Tract of Pupipara.‖ — Dr. H. S. Pratt has studied this in *Melophagus ovinus*, the larva of which was the subject of a previous investigation.¶ The ovary conforms to the Dipterous type—

* Comptes Rendus, cxxix. (1899) pp. 455–7.
† Zool. Anzeig., xxii. (1899) pp. 369–71.
‡ Atti R. Accad. Lincei (Rend.), viii. (1899) pp. 431–8. Cf. this Journal, *ante*, p. 155.
§ Ann. and Mag. Nat. Hist., iv. (1899) pp. 69–73, translated from Tijdschr. Nederland. Dierk. Ver., 1898, pp. 29–34.
‖ Zeitschr. f. wiss. Zool., lxvi. (1898) pp. 16–42 (2 pls. and 1 fig.).
¶ Arch. Naturges., iiii. (1893).

the nutritive cells being included in each follicle with the ovum, just above it or distal to it. The ovariole is almost exactly similar to that of *Musca*. The oviducts are very highly modified from the typical condition. At the anterior end of the uterus the dorsal surface is pierced by an opening, through which enters the nutritive secretion of the two pairs of milk-glands. The whole system is described in detail.

Instinct and Tropism in Insects.*—Mr. W. M. Wheeler points out that in the hovering of many insects, the insects adopt positions having fixed relations to the air currents. To this phenomenon he gives the name of anemotropism, this being positive or negative according to the position of the insect's head relative to the direction of the wind. This anemotropism is, according to the author, only a particular form of rheotropism, or the response which organisms make to the conditions to which their existence in a fluid medium exposes them. He believes that most of the responses to environment displayed by organisms are mere reflexes, and that the so-called instincts are mostly as purely mechanical in origin as the movements of *Mimosa* leaves after a sudden blow. They are due to the various tropisms, and the psychical factor is introduced needlessly.

Flowers and Insects.†—In his latest paper on this subject, Mr. C. Robertson discusses the following questions:—(1) Comparison of the genera of bees observed in Central Germany and in Illinois, with the number of species of each and their flower-visits; (2) The flower-visits of oligotropic bees; (3) Competition of flowers for the visits of bees; (4) The influence of bees in the modification of flowers; (5) The supposed pollen-carrying apparatus of flies and birds. He rejects, as fatal to the theory of natural selection, the hypothesis that, on the head of the ruby-throated humming-bird are feathers which are specially modified for carrying pollen.

Development of Lepidoptera.‡—Dr. Erich Schwartze has undertaken the investigation of the origin of the mid-gut in Lepidoptera, in the hope of settling the dispute as to the cells from which it arises. Three positions have been held on the subject,—(1) that it originates from the yolk-cells; (2) from anterior and posterior endodermic primordia which are separated from the endomesoderm soon after the origin of the latter from the ectoderm; (3) that it together with the remainder of the gut arises from the ectoderm. The author's investigations point conclusively to the last position. He finds that fore-gut and hind-gut arise from ectodermic invaginations, and from these invaginations lateral lamellæ arise which grow towards one another, and ultimately fuse together and form the mid-gut. Save for its mesodermal muscularis the mid-gut is therefore as purely ectodermal in origin as stomodæum and proctodæum. The yolk-cells separate themselves from the other cells before the formation of the blastoderm, and remain lying within the yolk without receiving any increase in number from cells migrating from the blastoderm. Certain cells (paracytes) do migrate

* Arch. f. Entwick.-mech., vii. (1899) pp. 374–81. See Zool. Centralbl., vi. (1899) pp. 695–7.
† Bot. Gazette, xxviii. (1899) pp. 27–45. Cf. this Journal, 1898, p. 445.
‡ Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 450–96 (4 pls.).

from the germinal streak and the mesoderm into the yolk, but these speedily undergo degeneration and do not become yolk-cells. The mesoderm has a variable origin, and may originate in different ways in the different parts of the same embryo.

In a discussion of the theoretical bearing of these results, the author draws the following conclusions from his own observations and those of others on the endoderm of insects. The yolk-cells represent the true endoderm (Heymons, Lécaillon); in *Campodea* they are directly converted into the epithelium of the mid-gut (Heymons); in *Lepisma* and the Odonatæ part form the mid-gut and part degenerate; in the Lepidoptera and other higher insects the yolk-cells (endoderm) wholly degenerate and the ectoderm takes on their function; in the Aphidæ the yolk-cells are few in number (Will), so that the endoderm is greatly reduced; finally, in some parasitic Hymenoptera there is neither yolk nor yolk-cells (Koulaguine), so that the endoderm is entirely absent. It would thus appear that there are organisms without any true inner layer, so that it cannot be said that an intrinsic physiological distinction exists between ectoderm and endoderm. The method of origin of the yolk-cells in some insects is such as to make it extremely difficult to apply the usual scheme of gastrulation. Both on physiological and morphological grounds, therefore, the author doubts the possibility of homologising the germinal layers throughout the animal kingdom, and believes that in the study of the phylogeny of the Metazoa the value of the germ-layer theory has been overestimated.

The investigation was carried out chiefly on eggs of *Lasiocampa fasciatella* Mén. var. *excellens*, but other material was used for comparison.

Variation in Butterflies.* — Prof. J. W. Spengel describes, under the name of "aberrations," a number of forms of *Papilio machaon*, in which the deviation from type seems to be greater than that in "normal variations." The examples described are both such as have been found in natural conditions and such as are produced by experimental breeding. One of the most interesting cases is the *aberr. nigrofasciata*, which occurs in natural conditions from unknown causes, in autumn from broods kept under the influence of very low temperatures, in spring from broods subjected to no artificial conditions of temperature. No general conclusions are drawn, but the evidence seems to be against the view that the temperature acts directly in producing deviation from type in butterflies.

Testis of Hydrophilus.†—Herr C. de Bruyne has studied the histology of this organ with special reference to the follicular cells of the seminiferous tubules. Each tubule contains a number of these follicular or enveloping cells which surround the spermatogonia. Both follicular cells and spermatogonia originate from the primitive germinal epithelium, but the function of the follicular cells is merely to protect and nourish the developing spermatozoa. When the sperms are mature the follicular cells undergo degeneration and break down. In the ovary of insects in general there are similarly two kinds of cells, the folli-

* Zool. Jahrb. (Abt. Syst.), xii. (1899) pp. 337–84 (3 pls. and 5 figs.).
† Anat. Anzeig. (Ergänzungsheft), xvi. (1899) pp. 115–23 (4 figs.).

cular cells and the true ova. The former, in origin, structure, and function, are apparently the equivalents of the follicular cells of the testis. A point of some interest is the relation of these cells to the cells of Sertoli in mammals. The author believes that they are the homologues of the cells of Sertoli, but they present many differences from the conditions described by several authors for the latter. Thus they are not interstitial cells as some suppose Sertoli's cells to be; they do not give rise to spermatogonia; they are not the residue of cells which have given rise to spermatozoa; they are not products of degeneration; they do not form a syncytium (cf. Regaud, *supra*, p. 575); all of which assertions have been made by different authors for the cells of Sertoli. In brief, the follicular cells of insects are hypertrophied primitive spermatic cells, which ultimately break up to feed the spermatozoa.

Post-embryonic Development of Entomophagous Hymenoptera.*—L. G. Seurat has made an elaborate series of investigations on this subject with special reference to the Braconidæ. The observations have in large part been made on *Doryctes gallicus* Rh., whose larvæ are external parasites of the larvæ of longicorn beetles. The paper is divided into three parts. Of these the first contains an account of the anatomy of the adult *Doryctes gallicus* and a description of the phenomena of the brief adult life (mating, egg-laying). In the second part the general phenomena of larval life in the Braconidæ, Ichneumonidæ, and Chalcididæ are described and compared, while the third part is devoted to a detailed study of the larval life of *Doryctes gallicus*. The following are the more general conclusions deduced by the author from his investigations. He agrees with Rheinhard and Janet in finding that the thorax of the Hymenoptera consists of four segments, and bears three pairs of stigmata. The number and distribution of the stigmata of the abdomen vary not only in different families, but within the limits of a single family. In the female *Doryctes* the gut and the Malpighian tubules are greatly reduced, the condition of the former rendering food-taking in adult life impossible. The ovaries, on the other hand, display a high degree of development, all the eggs being mature at the same time. The genital armature arises from the two penultimate segments of the abdomen. As to the larvæ, the simplest case is where these are external parasites. They then suck the tissues of the host through a small aperture in the latter's skin. The stomach is enormously enlarged, and does not communicate with the rectum until after the formation of the cocoon at the end of larval life. In larvæ which are internal parasites, the alimentary canal is similar to that of the external forms, but the tracheal system is closed and respiration takes place through the skin. The larvæ can move about within the host, and are possessed of a special locomotor organ whose significance has hitherto not been recognised. The tracheal systems of different larvæ show marked differences which are of considerable systematic importance.

Life-history of Trama radicis.†—S. Del Guercio gives an account of this root-aphis, describing the parthenogenetic form which begins the cycle, the winged forms which migrate from one plant to another, and

* Ann. Sci. Nat., x. (1899) pp. 1–159 (5 pls. and 16 figs.).
† Bull. Soc. Entomol. Ital., xxx. (1899) pp. 187–98 (6 figs.).

finally the males and females. It is also noted that *Lasius flavus* Fab. sometimes takes the eggs in charge, and that the Aphis contains a Nematode parasite.

Mouth-parts of Collembola.*—Mr. J. W. Folsom has brought to a successful conclusion a difficult and much-needed piece of work,—an analysis of the mouth-parts of the Collembolan *Orchesella flavopicta* Pack., synonymous with *O. cincta* L. of Europe. He describes mouth, pharynx, œsophagus, tentorium, labrum, mandibles, maxillæ, palpi, glossa and paraglossa, labium, and cephalic glands. The musculature of the parts is carefully discussed. Mr. Folsom then traces the history of the food until the stomach is reached, giving an account—necessarily inferential—of the physiology of the mouth-parts, to which scarcely any attention has hitherto been paid.

Regeneration in Orthoptera.†—M. Edmond Bordage continues to substantiate the adaptive character of regeneration. In saltatorial Orthoptera, it is not possible to provoke autotomy of the first two pairs of legs. By force they may be broken across the trochanter-coxa articulation, or more rarely across the femur-trochanter articulation. It is strange, however, that if regeneration takes place at all, it is most frequent and most complete when the breakage was across the femur-trochanter joint, i.e. where it most rarely occurs.

The explanation offered is that in natural exuvial autotomy the rupture is most frequent and least dangerous across the femur-trochanter joint.

He further notes that any appendage may suffer loss in moulting; that the tarsus is most readily injured and most readily regenerated; that in *Phylloptera laurifolia* and *Conocephalus differens* the regenerated tarsus is tetrameral (normal in Locustidæ), that in *Gryllus campestris* the regenerated tarsus has three joints; and that the regenerated anterior limbs of Locustidæ and Gryllidæ have no tympanic apparatus.

Corpora allata of Bacillus.‡ — Dr. R. Heymons has studied two peculiar vesicles which are seen if one opens the head of *Bacillus rossii* F. (a European stick-insect) from the dorsal side and examines the posterior half close to the gullet. They may be recognised by their milk-white colour; and even with a lens it may be seen that they are closely connected with the pharyngeal ganglion. They arise from ectodermic ingrowths, at first apparently solid, and they are neither ganglionic nor glandular. Similar bodies, which the author calls by the indifferent name "corpora allata," occur in other Orthoptera, in Dermaptera, Hymenoptera, Rhynchota, and Lepidoptera; but what distinguishes those of *Bacillus* is the presence in a vesicular cavity of a central chitinous sphere surrounded by successive lamellæ of chitin. Their function remains quite obscure, but it is possible that they have something to do with the visceral nervous system.

Eumasticides.§ — Mr. M. Burr uses this new name for a tribe of Acridiodea—of which he gives a systematic account. There is particu-

* Bull. Mus. Comp. Zool., xxxv. (1899) pp. 7–39 (4 pls.).
† Comptes Rendus, cxxix. (1899) pp. 169–71.
‡ SB. K. Preuss. Akad. Wiss., 1899, pp. 563–75 (2 figs.).
§ Ann. and Mag. Nat. Hist., viii. (1899) pp. 75–112 (plates to follow).

lar interest attached to the forms in question, e.g. *Chorœtypus*, *Erianthus*, *Erucius*, *Mastacides*, *Gomphomastax*, not only because of the quaint colours, bizarre forms, and imperfectly understood adaptations, but also because the members of the tribe are relatively rare.

"Corselet" of Ant.*—M. Charles Janet describes the minute structure of the "corselet" of a queen *Myrmica rubra*, and discusses the movements of the tegumentary skeleton of the mesothorax during flight, and the nine pairs of muscles by which these movements are produced. He promises to give, in a further note, the results of his observation of the phenomena of histolysis which the vibratory muscles undergo when they have become useless through the falling-off of the wings. At the end of the season and in early winter the products of this histolysis furnish part of the aliment necessary to the formation of the eggs from which the first workers of the colony are developed.

Tegumentary Glandular System of Myrmica rubra.†—In continuation of his work on ants, bees, and wasps, M. Charles Janet publishes notes on the tegumentary glandular system of *Myrmica rubra*, and on the sting and the mechanism by which the poison-gland is closed in the same species. He defines as tegumentary all such glands as are formed directly from the tegument and open at its surface, thus excluding the glands connected with the alimentary canal. The cells of all the integumentary glands are large. They have a large nucleus, a clear vacuole, and a fine chitinous excretory canal prolonged to the exterior, and similar to the intracellular canals which have been studied by other investigators in some species of *Formica* and in the Coleoptera. M. Janet names and figures eight pairs of tegumentary glands in *M. rubra*, describing the structure and probable function of each pair. In another "Note" he gives a full account of the minute structure of the sting, and of the poison-gland and its closing-apparatus.

β. Myriopoda.

Branchial Respiration in Diplopoda.‡ — M. Causard observed in *Brachydesmus superus* Latzel and *Polydesmus gallicus* Latzel, submerged in water, the evagination of a transparent rectal pouch, which showed fine tracheæ and blood-currents. He interprets this as a mode of branchial respiration. In *Iulus* the evagination of a rectal pouch was also observed. According to the observer, the facts suggest the probability that the Myriopods had an aquatic origin, and that the Diplopoda are more primitive than the Chilopoda.

Palæarctic Myriopoda.§—Dr. Carl Graf Attems publishes an important systematic paper on this subject, which includes descriptions of several new species and notes on anatomy. He also discusses the morphology of the anal legs and maxillipedes of the Chilopoda, and concludes that in the Scolopendridæ the anal legs have neither coxa nor trochanter, while in the Geophilidæ the coxa is usually absent.

* Mém. Soc. Zool. France, 1898, pp. 393–450 (1 pl. and 25 figs.).
† 'Études sur les Fourmis, les Guêpes et les Abeilles,' Carré and Naud, Paris, 1898, Note 17, 30 pp. and 9 figs.; Note 18, 25 pp. and 3 pls.
‡ Comptes Rendus, cxxix. (1899) pp. 237–9.
§ Zool. Jahrb. (Abt. Syst.), xii. (1899) pp. 286–336 (3 pls.).

Palæarctic Geophilidæ.*—Dr. Carl Verhoeff publishes a short systematic paper on this subject, and adds to it a short discussion of Attems' views on the morphology of the legs. He believes that the ordinary walking legs have seven joints, but the coxa has hitherto been incorrectly regarded as episternum. The anal or terminal legs have the same structure, the coxa being present in them as in the others. He believes that this view removes many difficulties and apparent contradictions.

δ. Arachnida.

Structure of Pseudoscorpionidæ.†—Dr. F. Supino has studied *Chernes hanii* Koch or *Chelifer cimicoides* Fabr. He describes:—(*a*) the pair of cephalothoracic glands whose ducts open at the apex of the cheliceræ, and probably have a poisonous secretion; (*b*) the pair of silk-glands behind (*a*) and in front of the reproductive organs; and (*c*) the pair of adhesive glands behind the reproductive organs. The abdominal gland which fills most of the cavity of the body is probably excretory as well as digestive, and should be called a "a hepato-pancreato-nephric" gland. The heart extends from the cephalic ganglion to the fourth abdominal segment; it has three lateral ostia, and is tripartite posteriorly. It is enveloped in a network of longitudinal and oblique muscles. In regard to the reproductive organs, it is noted that the testis is unpaired and median, and is divided by connective-tissue into compartments. On the whole, the work of Croneberg is confirmed.

North American Species of Atax.‡—Mr. R. H. Wolcott has made a study of the North American species of this Hydrachnid genus. Almost all are confined to fresh-water mussels, but two are free living. The account deals with thirteen species, of which seven are new. There is little variation, and the specific characters are well defined. In addition to the systematic description, there is a chapter on the general life. "The strange thing is that under conditions so stable, so many species should occur. In this respect, as compared with the European fauna, ours seems remarkably rich, since we have now thirteen recorded species of *Atax* as compared with eight from all parts of the continent of Europe."

Position of Pentastomida.§—Herr J. E. W. Ihle discusses the confessedly somewhat slim arguments which have been used to justify the prevalent association of Pentastomida with Arachnoidea. He does not find them in any way satisfactory, and denies that there is any affinity. The Pentastomida are, in his opinion, to be regarded as forming a class by themselves, within the sub-phylum Tracheata, and derivable from the hypothetical Prochilopoda intermediate between Protracheata and Myriopods.

ε. Crustacea.

Movements of Copepods.‖—Prof. E. W. MacBride points out that the movements of a species (unnamed) of marine Copepod, which he

* Zool. Anzeig., xxii. (1899) pp. 363–8.
† Atti R. Accad. Lincei, viii. (1899) pp. 604–8 (3 figs.).
‡ Trans. Amer. Micr. Soc., xx. (1899) pp. 193–259 (5 pls.).
§ Biol. Centralbl., xix. (1899) pp. 608–14.
‖ Quart. Journ. Micr. Sci., xlii. (1899) pp. 505–7.

observed at Plymouth, are of two kinds,—a slow gliding movement and a sudden dart of lightning swiftness. During the slow movements, the antennules or first antennæ (usually held to be the most important locomotor organs) are held rigidly extended at right angles to the long axis of the body, their appearance suggesting the idea that one of their functions may be to act as hydrostatic sense-organs. The movement is effected principally by means of the second antennæ (as in the Nauplius), the gnathites also assisting, especially the second maxillæ. It seems probable that feeding is carried on during these slow movements. The quick movements are effected entirely by the simultaneous action of the four pairs of powerful thoracic paddles. He notes, however, that in the fresh-water *Cyclops* the first antennæ do assist in the slow movements.

Statocyst Function.* — Th. Beer finds that *Penæus membranaceus* is well-suited for illustrating the equilibrating function of statocysts. When these organs are extirpated, the animal fails to keep its balance in swimming; it falls to one side, or in an unnatural position on the ground.

Annulata.

Polychætes of Brest and of Paimpol.† — Baron de Saint-Joseph describes a small collection of Annelids from these localities, and contrasts generally their fauna with that of Dinard. The paper contains notes on habits and distribution, and also a description of a remarkable new form, *Pilargis verrucosa* g. et sp. n., which seems to be related to Webster's *Phronia tardigrada* Webst., and for which the author erects a new family, the Pilargididæ.

Development of Oligochætes.‡—Dr. R. W. Hoffmann has investigated some points in the development of *Allolobophora putris* Hoffm., whose embryos, on account of the small amount of albumen present, are well-suited for embryological work. As to the development of the alimentary canal, he finds that the gastrula arises by invagination, and that the blastopore becomes directly converted into the mouth. The stomodæum originates from very large cells near the excretory cells, and at the same time the archenteron closes up. The stomodæum grows out into a slender hyaline tube, which later acquires an S-shaped curve. Of the parts of the stomodæum the pharynx is the first to be differentiated, and it certainly arises from ectoderm. Of the parts of the mid-gut the œsophagus is the first to be differentiated, crop and gizzard arise from a swelling behind it, and the remainder of the mid-gut becomes the intestine with its typhlosole. Contrary to Wilson's observations, the author finds it easy to distinguish proctodæum from mid-gut; for until late in development the proctodæal invagination is differentiated by its physical and staining reactions. He finds that at the time when the proctodæum first opens into the mid-gut, the former extends through four segments of the body, but, as segment formation is still going on, it is probable that ultimately the ectodermal hind-gut occupies seven or eight segments of the body.

* Pflüger's Arch. f. Physiol., lxxiv. (1899) pp. 364–82. See Zool. Centralbl., vi. (1899) p. 631.

† Ann. Sci. Nat., x. (1899) pp. 161–94 (1 pl.).

‡ Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 335–57 (2 pls. and 5 figs.).

The larval excretory organs appear at a very early stage, and consist of large vacuolated cells. These are probably secondary organs, adapted for life in a cocoon. The author's observations on the pronephridia of the embryo do not wholly agree with those of any previous observer. He finds that they originate in the head-cavity into which they open. are lined with cilia, and exhibit very distinct nuclei. They appear to transmit the products of metabolism from the head-cavity to the exterior. The author doubts the possibility of homologising the pronephridia of leeches and Oligochætes, at least in any detail.

Kinberg's Oligochætes.*—Dr. W. Michaelsen has re-examined the collection of Oligochætes originally described by Kinberg.† The collection consisted of specimens taken by the 'Eugenie' expedition and some other specimens in the Stockholm Museum. Kinberg's descriptions and diagnoses were mostly very inadequate, and Michaelsen refers his genera and species to their true position, rejecting many of the species as based on immature specimens.

Supposed Encystment of Pachydrilus catanensis Drago.‡—Dr. Luigi Cognetti has a short note on this species. Drago § described it as undergoing encystment, the cysts containing two small individuals, displaying all the characters of the adult worm, but of small size. These and the other characters of the "cyst" are so remarkable and so different from the conditions seen in the encystation of *Æolosoma*, that Cognetti is unable to accept the term. He believes that the "cyst" is nothing but the cocoon displaying all the characters common to the cocoons of other Enchytræidæ.

Snow-inhabiting Enchytræid.‖—Mr. J. Percy Moore describes *Mesenchytræus solifugus* Emery collected upon the snow of the Malaspina Glacier on Mount St. Elias. A very striking peculiarity of the species is the yellow-brown, deep chocolate-brown, or almost black colour, and its opacity. This melanism—whatever be its explanation—is known in many other snow-inhabiting animals. The author briefly discusses the problem of coloration, and also the more general one suggested by the fact that this snow-worm lives and grows while maintaining a bodily temperature about the freezing point of water.

Structure of Thalassema neptuni.¶—Mr. H. Lyster Jameson has investigated the anatomy and histology of this Echiuroid. He finds that the body-wall consists of an external cuticle and an epidermis which contains four different types of elements. Beneath the epidermis lies the cutis, three layers of muscles, and a peritoneum. The digestive organs consist of fore-gut, made up of pharynx, œsophagus, gizzard and crop, mid-gut or intestine, and rectum. The intestine exhibits a reversal of the ordinary relations of the musculature (cf. Capitellidæ). It is divided into three parts, of which the median has a collateral intestine continuous at either end with a ciliated groove lying in the anterior and posterior regions of the intestine. Remarkable glands occur in crop and œsophagus, and possibly secrete the mucus found

* Öfvers. K. Vet-Akad. Förh., lvi. (1899) pp. 413–48. † Op. cit., 1866.
‡ Zool. Anzeig., xxii. (1899) pp. 381–3. § Ricerche R. Univ. Roma, vii. (1899).
‖ Proc. Acad. Nat. Sci. Philadelphia, 1899, pp. 125–44 (1 pl.).
¶ Zool. Jahrb. (Abt. Anat.), xii. (1899) pp. 535–566 (3 pls. and 1 fig.).

mingled with the sand in the intestine. The vascular system in its general relations agrees with that of *Echiurus*.

Testes of Leech.*—Prof. A. Schuberg has investigated the minute structure of the testes and vas deferens in *Hirudo* and *Aulastomum*. The conditions in the two genera are almost identical. Particular attention is devoted to the testicular epithelium—a single layer of cells which exhibits an almost continuous series from typical epithelial elements to cells which closely resemble those of gelatinous connective-tissue.

Cœlom and Vascular System in Leech.†—Mr. E. S. Goodrich has endeavoured to ascertain whether in *Hirudo medicinalis* the cavities of the so-called sinus system do or do not communicate with those of the contractile vascular system. According to the older interpretations such a connection existed, but the recognition of the sinuses as cœlomic made their connection with the vascular system seem very improbable. The result of Mr. Goodrich's researches (by injections and by sections) is to show that the continuity does exist.

The injection experiments, in which Mr. L. J. Picton shared, showed that both in *Aulastoma* and in *Hirudo* blood-vessels, sinuses, and botryoidal tissue are in free communication. The communication takes place through the capillary system.

The hæmolymph system of *Hirudo* consists of four main longitudinal trunks, sending out transverse branches to the body-wall. The dorsal branches of the lateral vessels pass into small annular vessels communicating with the plexus of minute capillaries in the epidermis. From these, again, arise capillaries going to small sinuses which run into the lateral transverse sinuses, and so into the dorsal sinus.

Similarly the ventral sinus sends annular sinuses along the ventral region of the body-wall opening into the epidermal plexus, whence arise capillaries joining the latero-abdominal vessels.

Continuity between the two systems has also been shown to take place by means of capillaries on the wall of the alimentary canal, and probably exists on the other internal organs of the body.

The presence of valves, which the author describes, shows that the hæmolymph must flow in a constant direction. "It seems extremely probable that the annular vessels collect the oxygenated blood from the epidermal plexus, and carry it into the latero-dorsal and latero-lateral vessels, whence it would be pumped into the lateral vessels. From these some of the hæmolymph must be carried by the latero-abdominal vessels to the various organs of the body, and to the ventral cutaneous plexus. The annular sinuses would collect it from this plexus, and carry it into the ventral sinus. The abdomino-dorsals and the dorsal sinus would appear to supply the dorsal and lateral cutaneous plexus."

That the lateral vessels belong to the real vascular system, and that the ventral sinus and perinephrostomial sinuses belong to the true cœlomic system, seems certain. Mr. Goodrich is inclined to think that the dorsal sinus may represent the dorsal vessel of other Annelids. The annular channels may possibly represent the annular cœlomic lacunæ described by Oka in *Clepsine*, and it may perhaps be through them that

* Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 1–15 (1 pl.).
† Quart. Journ. Micr. Sci., xlii. (1899) pp. 477–95 (3 pls.).

the chief communication between the cœlom and the vascular system has been established. It seems fairly certain that it is not only by means of the botryoidal channels that the communication has been brought about. The botryoidal channels seem to be rather of the nature of a by-path, through which the hæmolymph does not necessarily circulate.

"Whatever may be the process whereby the continuity between the cœlom and vascular system has been established in the Gnathobdellidæ, there can be little doubt that it is a secondary condition, and that the structure of such a form as *Acanthobdella*, in which a closed blood-system lies in a normally developed cœlom, is really the more primitive."

Development of Segmental Organs.* — Herr R. S. Bergh, having obtained recently an abundant supply of *Rhynchelmis* material, has returned to the examination of the developing nephridia. He finds that the cells which later form the coil and excretory tube of the nephridium originate in a median and obliquely dorsal direction from the nephridioblasts, while the four cells of the lower lip arise later from the nephridioblasts by equal division. The upper lip arises out of finely granular cells lying to the middle of the nephridioblasts. Vejdovsky's "vacuole" appears to be merely a diverticulum of the segmental cavity. The author believes that his former statement as to the origin in Oligochætes in general of funnel, coil, and terminal portion from a single primordium is true also of *Rhynchelmis*, but the funnel primordium is early differentiated into upper and under lip, and the coiled region grows out of the under lip. In general, Bergh does not find that his earlier statements require any modification on account of Vejdovsky's work.

Rotatoria.

Rotatoria of Fresh-water Plankton.†—Dr. G. Marpmann (over the signature M.) gives a very brief, unsatisfactory, and in part inaccurate account of the class Rotifera, with a number of mistakes and misprints in the names, and classifications by Eifert and Daday which have not been accepted by any other student of the class. In speaking of Rousselet's method of preserving Rotatoria, the author states that, after fixing, the animals are passed through 70 and 80 per cent. into absolute alcohol, and then into xylol and balsam. Surely the author must have been dreaming all this, for nothing of the kind is done in Rousselet's method; on the contrary, all contact with strong alcohol and balsam is carefully avoided.

Nematohelminthes.

Unusual Expulsion of Ascaris lumbricoides.‡—Dr. G. Alessandrini records two cases observed within a year; the first of a lady from whose gullet he extracted a male worm; the second of a child of four years in which the worm occurred in the trachea. Both were successfully treated.

North American Gordiacea.§—Dr. T. H. Montgomery publishes a useful list of the Gordiacea of the United States, with keys for the

* Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 435–49 (1 pl.).
† Zeitschr. f. angew. Mikr., iv. and v. pp. 105–112 and 139–42.
‡ Boll. Soc. Rom. Stud. Zool., viii. (1899) pp. 83–4.
§ Amer. Nat., xxxiii. (1899) pp. 647–52.

determination of species, literature lists, and notes as to habits and life-history.

Platyhelminthes.

New Pelagic Nemertean.* — Prof. W. McM. Woodworth gives a preliminary account of *Planktonemertes agassizii* g. et sp. n., a new pelagic Nemertean from the 'Albatross' collection, which, like the only other genus, the 'Challenger' *Pelagonemertes*, was taken in the Pacific Ocean, and in trawls from considerable depths. There are many points of resemblance between the two forms—in form, colour, and even finer structure—but a comparison shows the necessity of establishing a new genus in Moseley's family Pelagonemertidæ. The distinctive features are :—a common external opening for the mouth and proboscis, supra-œsophageal ganglia smaller than subœsophageal, median dorsal vessel present, and lateral diverticula of the intestine very numerous. As with the 'Challenger' forms, the specimens (except one which was not sectioned) proved to be females.

Adhesion of Cestodes to Intestinal Wall.† — Pio Mingazzini has studied, by means of sections, the different modes of adhesion. There is considerable diversity. The majority of the scolices are superficially attached to the mucous membrane, and their hooks only penetrate between the epithelial cells; others, e.g. *Calliobothrium*, have very strong hooks which reach to the subjacent connective-tissue, destroying the epithelium at the points traversed; others, e.g. *Stilesia*, cause considerable inflammatory neo-formation of vessels and connective-tissue; others, e.g. some species of *Calliobothrium*, destroy a considerable tract of epithelium, and actually penetrate into a blood-vessel.

New or Rare Trematodes.‡ — Herr M. Kowalewski has found specimens of the rare *Echinostomum spathulatum* which infests *Botaurus minutus*, and which has only been once described previously. Its most interesting peculiarity is the presence of two ventral suckers, which act like the ambulacral feet of Echinoderms, in that the dermal muscles do not act upon them directly, but upon the excretory system, whose contents then enter the sucker. The other interesting peculiarities of the parasite are figured and described in detail. The paper also includes descriptions of three new forms of *Opisthorchis*, and a general discussion on the species of this difficult genus. It describes in detail the occurrence of that remarkable inversion of sexual symmetry which has already been noted. It is remarkable that in this genus, of the individuals living in one host, half will be found to have the unsymmetrical sexual organs at one side of the body, and the other half at the other side, so that the one set form mirror images of the other. The biological significance of this remarkable fact is unknown. The paper also includes some account of the anatomy and habits of *Bilharzia polonica*.

Incertæ Sedis.

New Zealand Species of Balanoglossus.§ — Prof. W. Blaxland Benham gives a short account of *Balanoglossus otagoensis* sp. n., the first

* Bull. Mus. Comp. Zool. Harvard, xxxv. (1899) pp. 1-4 (1 pl.).
† Atti R. Accad. Lincei, viii. (1899) pp. 597-603 (6 figs.).
‡ C.R. Nat. Ac. Sci. Cracovie, xxxv. (1898) pp. 106-64 (2 pls.) (Polish). German abstract in Zool. Centralbl., vi. (1899) pp. 691-3.
§ Quart. Journ. Micr. Sci., xlii. (1899) pp. 497-504 (1 pl.).

example of the Hemichorda from New Zealand, and the first representative of the genus as yet reported from the Southern Hemisphere. The proboscis is deeply grooved along the whole of its dorsal surface; the proboscis-cavity extends right to the tip of the organ; the longitudinal muscles of the proboscis form a very narrow band close to the wall; there is but a single proboscis pore; there are no median gonads; there is a single pair of intestino-tegumentary canals; the arms of the sub-notochordal skeleton reach backwards to the level of the collar-pore.

"Notochord" of Cephalodiscus.* — Dr. A. T. Masterman returns to the discussion of the points at issue between Dr. Harmer and himself. Further investigation of *Cephalodiscus* has convinced him that the pericardium of this form is homologous with the proboscis-vesicle of *Balanoglossus*, and therefore the comparison of the latter with the sub-neural gland of *Cephalodiscus* must be given up. Again, Masterman has so far modified his views on the homologies of the notochord (= sub-neural gland) of *Cephalodiscus* as to now believe that this organ is equivalent to the vermiform process of the "Eicheldarm" in *Schizocardium*, *Glandiceps*, and *Spengelia*. Masterman reaffirms his belief in that view of the homology of the "notochords" of *Cephalodiscus* indicated in the name Diplochorda, and believes that the Enteropneusta will be found to fall into this group as well as *Cephalodiscus*, *Phoronis*, and *Rhabdopleura*.

Budding in Ectoproctous Bryozoa.† — Herr Franz Ladewig, in a preliminary note, indicates the chief differences between his own observations and those of Calvet. According to Calvet ‡ the bud originates from proliferated ectoderm cells which group themselves round mesenchymatous elements in the body-cavity of the mother-polype. Ladewig, on the contrary, finds that the bud originates from an ectodermic invagination in the way described by Nitsche and Claparède. His observations also confirm Nitsche's view that the avicularium corresponds to the nerve-organ of an aborted polypide.

Echinoderma.

Development of Echinoids.§—Prof. E. W. MacBride has succeeded in rearing larvæ of *Echinus esculentus* and *E. miliaris* up to the latest pluteus stage. He gives clear drawings of the two species at different stages, and points out the minute differences between them. The eggs of *E. miliaris* are smaller than those of *E. esculentus*, and it was not found possible to keep the larvæ alive so long in the former as in the latter case. The difference seems to depend upon the smaller supply of food-yolk in the eggs of *E. miliaris*.

Cœlentera.

New Unattached Marine Hydroid.‖ — Mr. L. Murbach describes a new form of marine hydroid, *Hypolytus peregrinus* g. et sp. n., which he found at Wood's Holl. It is, in the first place, remarkable in being unattached, thus resembling *Protohydra leuckartii* and *Halermita cumu-*

* Zool. Anzeig., xxii. (1899) pp. 359–63. Cf. this Journal, 1898, p. 81.
† Tom. cit., pp. 355–7. ‡ Cf. this Journal, 1898, p. 632.
§ Quart. Journ. Micr. Sci., xlii. (1899) pp. 335–9 (1 pl.).
‖ Tom. cit., pp. 341–60 (1 pl.).

lans. These, however, may turn out to be larval, for their respective discoverers, Greeff and Schaudinn, did not observe any sexual reproduction, whereas Murbach found gonophores on *Hypolytus.*

It is a single unbranched polyp of the Tubularian type, with two circles of tentacles, ten in the upper and fourteen in the lower. A primitive perisarc envelopes the hydrocaulus, at the free end of which buds are given off by spontaneous fission. These in turn develope directly into polyps like the parent. Ova and spermatozoa are developed in gonophores situated just above the aboral circle of tentacles. The polyp moves slowly from place to place.

Mr. Murbach also describes *Corynitis agassizii* McCrady and its medusoid, which is identical with *Gemmaria gemmosa* McCrady. He notes, *inter alia*, that the polyps of the European and American *Gemmaria* are generically distinct, and yet the medusoids are almost identical.

Development of Aurelia aurita.*—Herr Walter Hein gives a brief summary of his results on this subject. The blastula consists of a hollow cone of similar cells with a ventral blastocœl. Certain cells wander out of the blastoderm and undergo degeneration in the blastocœl, but delamination does not occur. Endoderm arises by a typical invagination, but the cells show considerable variations in form and size, which are probably due to differences in nutrition. Later these differences disappear. The blastopore does not close entirely, but persists as a narrow canal which, after the fixation of the larva, widens out into the permanent mouth. During gastrulation isolated cells of the endoderm may go free, and then finally degenerate in the cavity of the archenteron. These degenerating cells are quite distinct from those of the blastula stage, fragments of which may be found between the two embryonic layers. When the gastrula elongates to form the planula, the endoderm of the oral pole can be distinguished from that at the aboral by the smaller size of its constituent cells. This proliferation of oral endoderm increases with the fixation of the larva, but no trace of ectodermal gullet or gut-pockets was observed. The four primary tentacles originate simultaneously. Gastric ridges and grooves originate from the endoderm, and four ectodermal invaginations of the peristome form the muscles.

Abnormalities in Aurelia.†—Herr E. Ballowitz has followed other zoologists in making a study of the variations of *Aurelia aurita*, which seems a good subject for the modern statistical method to tackle. This jelly-fish seems to be extraordinarily variable; but perhaps this impression should be corrected by the fact that we know more about it than about many others. The variations are both peripheral and central. A whole paramere may be absent, or one may be added, or more than one. Sexpartite, pentapartite, and most rarely tripartite individuals occur. A tripartite *Aurelia* has a three-cornered mouth, three genital pouches, six marginal bodies, &c., but often the variation is not so uniform throughout. Some of the abnormalities may date from the Ephyra-stage, but most must have a much earlier origin.

* Zool. Anzeig., xxii. (1899) pp. 353–4.

† Arch. Entwickmech., viii. (1899) pp. 239–53 (1 pl.). See Zool. Centralbl., vi. (1899) pp. 626–8.

Structure of Xenia.*—Dr. J. H. Ashworth gives a full description of an Alcyonaceous coral, *Xenia hicksoni* sp. n., from North Celebes. The exceptionally perfect preservation of the specimens made a study of the minute internal structure possible. The species appears to differ from most if not all other members of the genus in the absence of spicules from the tentacles and pinnules.

Among the new points particularly noted are the following. The ventral and lateral mesenterial filaments usually present in the polyps of Alcyonaria are absent. Their absence is correlated with the presence of gland-cells in the stomodæum, especially in the ventro-lateral walls which abut on the siphonoglyph. The non-retractile nature of the bodies of the polyps and of the stems is accounted for by the absence of muscle-fibres from their ectoderm cells and by the presence of numerous spicules. But there are ectodermic muscles in the tentacles, pinnules, and distal millimetre of the bodies of the polyps; and as spicules are absent from these parts, there is slight contractility.

An extraordinary number of spicules is present in the basal part of the colony, and much of the mesoglœa is converted into a dense horny substance. Thus a firm base is formed. Many of the endoderm cells lining the cœlentera and tentacles bear giant flagella.

In adult polyps the primitive genital cells are formed by differentiation of some of the endoderm cells which cover the mesenteries. These genital cells migrate into the mesoglœa of the mesenteries, and then move outwards, one at a time, each cell pushing the endoderm and a thin film of mesoglœa before it, and so forming a small tubercle on the side or end of the mesentery. By division of the genital cell the spermatozoa are formed, and they remain until ripe, surrounded by a thin film of mesoglœa and by a layer of endoderm cells.

The longitudinal canals traversing the mesoglœa of the stem are very well developed, and are physiologically, and possibly morphologically, equivalent to the cœnenchymal tubes of *Heliopora cœrulea*. The nervous system resembles that of *Alcyonium*; the stellate cells immediately outside the endodermic muscle-fibres are very clearly seen.

Dr. Ashworth describes a complete series of developing polyps both in *Xenia hicksoni* and in *Heteroxenia elizabethæ*, the dimorphism of the latter being confirmed.

He traces the origin of the buds of *Xenia hicksoni* from the superficial canal system, their subsequent growth and differentiation. It is remarkable that the sex-cells are already differentiated in a young polyp 0·95 mm. in length.

Porifera.

Structure of Larva of Spongilla lacustris.†—Mr. R. Evans has investigated this subject in regard to which contributions and contradictions have abounded. His chief conclusions are the following.

There are different types of free-swimming larva, which are described as A, B, C, and D. Type A is the youngest form of all; type B is an intermediate form between A and C; while type D is a variation derived along a different line of development from type A.

* Quart. Journ. Micr. Sci, xlii. (1899) pp. 245-304 (5 pls.).
† Tom. cit., pp. 363–476 (7 pls.).

The flagellate cells of the larva in all cases become the collar-cells of the young sponge. Certain cells of the inner mass, distinguished by their vesicular nuclei and blastomeric characters, are capable of giving rise to collar-cells, as well as to the flat epithelium, &c., i.e. both to the dermal and to the gastral layer.

Consequently, during the metamorphosis of type C, flagellate chambers are developed from "cell-groups" derived originally from cells with vesicular nuclei situated in the inner mass, as well as from the flagellate cells.

In type D, however, hardly any cell-groups are formed, and consequently the gastral layer is developed almost completely from the flagellate cells of the surface layer.

The cell-groups and the flagellate cells of the larva are to be considered as belonging to the same class; the latter being developed on the outside, and consequently producing only flagella; while the former originate inside, and ultimately develope both collars and flagella.

All the cavities, canals, and surfaces are lined by cells possessing granular nuclei, which are capable of producing microscleres, even when they are situated in the flat epithelium of the surface layers. The megascleres are produced at first in cells with vesicular nuclei, which later on become granular.

Some of the cells with vesicular nuclei plaster themselves to the surfaces of the flagellate chambers in the young sponge, and become pore-cells, their nuclei subsequently changing in character and becoming granular.

There is always a residue of cells with vesicular nuclei which retain their blastomeric characters, and which are therefore capable of giving rise to the whole sponge. Some of these, or perhaps all of them, become wandering cells, and ultimately give rise to the gemmule which is capable of producing both the dermal and the gastral layers of the sponge.

The collar-cells multiply by karyokinetic division, and, owing to the multiplication of the collar-cells in the flagellate chambers, the latter become separated into two groups, and so produce two daughter-chambers.

The existence of choanocytes or collar-cells in the sponges, as well as their early appearance in the free-swimming larva, together with the ontogenetic method of differentiation found in the Ascones, the most primitive of sponges, incline the author to the conclusion that sponges have been evolved independently from Choanoflagellata. This conclusion is further strengthened by the consideration that collar-cells do not occur in any of the various phyla of the Metazoa.

Maturation and Fertilisation in Sponges.*—Dr. Otto Maas points out that cytological questions are hard to answer in the case of sponges. Even as regards karyokinetic division, the reports of it have hitherto been so doubtful that its occurrence has been altogether denied by some. As to the phenomena of maturation and fertilisation scarcely anything is known. Maas has however found mitotic division with unmistakable

* Anat. Anzeig., xvi. (1899) pp. 290–8 (12 figs.).

distinctness in embryos of *Sycandra raphanus*. In the history of the ovum, there is first a growth-period in which an amœboid cell becomes a definite ovum; then a ripening period, in which the germinal vesicle becomes smaller and more compact, and gives off polar bodies after mitotic division; then follows fertilisation, which leads immediately to the first segmentation division. The longitudinal axis of the first spindle always lies exactly in the longitudinal axis of the ovum. The illustrations showing spindle-figures with polar radiations and distinct chromosomes (of which the normal number seems to be 32) indicate a quite typical mitosis.

Protozoa.

Deep-water Rhizopods.*—Dr. Eugène Penard has made an exhaustive study of the Rhizopods of the depths of the Lake of Geneva. He gives lists with notes, descriptions, and figures of the characteristic forms, and contrasts the fauna of the Lake of Geneva with that of some other Swiss lakes. The Rhizopods flourish best at depths of from 30–50 metres; below this they seem to diminish both in number and variety. Although the physical conditions of light, pressure, and temperature are virtually constant throughout the year, the fauna is not constant, being smaller in winter than in summer. This is no doubt due to the fact that the Rhizopods depend for food on the diatoms of the upper waters, and these decrease or disappear in the winter months. As to the general characters of the deep water forms, it is noticed that they tend to reach a large size; in this respect they are contrasted with the more highly organised inhabitants of the same depths. Among other peculiarities are the apparent partial loss of functional power by the contractile vacuole, and of the power of encystation in many forms. Though symbiosis in the strict sense is impossible, some forms (e.g. *Difflugia elegans* var. *teres*) seem to possess the power of keeping the diatoms of the food alive and assimilating within their protoplasm for some time.

As to the origin of the Rhizopod fauna, the general similarity of the deep-water fauna of the Swiss lakes seems to be against the hypothesis of its independent origin in the different lakes. The only suggestion which the author has to offer is that this fauna is the remnant of a widely distributed glacial fauna.

Experiments on Difflugia.†—Dr. Eugène Penard found that separated pseudopodia of *D. lebes* and *D. pyriformis* behave for a short time like small amœboid organisms, but die in a few hours. Placed near the "parent" individual, a pseudopodium is attracted towards it and rejoins it; but its behaviour is just the opposite if the individual near which it is placed is not its "parent."

Notes on Foraminifera.‡—Prof. A. Silvestri describes the Pliocene *Biloculina globosa* Soldani, and shows that it merits distinctive specific rank; while the variety *cristata* of *Peneroplis pertusus* is allowed to be, as F. W. Millett and L. Rhumbler declared, merely based on specimens which have suffered corrosion.

* Rev. Suisse Zool., vii. (1899) pp. 1–142 (9 pls.).
† C.R. Soc. Phys. Nat. Génève; in Arch. Sci. Phys. et Nat., viii. (1899) p. 90.
‡ Atti Accad. Pontif. Nuovi Lincei, lii. (1899) pp. 68–73 (3 figs.).

Ciliata of Geneva.*— M. Jean Roux has made a faunistic study of the ciliated Infusorians around Geneva, and has discovered seven new genera.

Galvanotropism of Ciliated Infusorians.†—M. Henri Mouton, following experiments of Verworn and Ludloff, has shown that in an experiment with *Paramæcium* the current acts directly, and not through diffusible products formed near the electrodes. Other Infusorians (*Colpoda*) showed in presence of products of the electrolysis at the kathode a negative chemiotropism, which in the immediate neighbourhood of the electrode exceeded the effect of the positive galvanotropism, though counterbalanced by it at a greater distance.

New Species of Infusorians.‡—Mr. J. C. Smith continues his account of new members of the Infusorial fauna of Louisiana, describing new species of *Tetramitus*, *Enchelys*, *Tillina*, *Lembus*, and *Strombidinopsis*.

Organism of Tsetse Fly Disease.§—Mr. H. G. Plimmer and Prof. J. Rose Bradford have published a preliminary note on the structure and distribution of the organism found in the Tsetse fly disease, discovered by Major Bruce, and classed by him as a *Trypanosoma*, one of the Monadina (Flagellata).

They describe the adult form, and its distribution in the body of normal and spleenless animals; and they discuss the degrees of infectivity.

Tentatively they sketch the life-history of *Trypanosoma brucii*. There is reproduction by division of two kinds, more commonly longitudinal, less frequently transverse. There is conjugation, consisting essentially, so far as the investigators' observations go, in the fusion of the micronuclei of the conjugating organisms. Probably succeeding conjugation is the occurrence of forms in which the chromatin is broken up and diffused. The next stage is amœboid; but probably the flagellate forms may assume this phase apart from conjugation. The amœboid forms, which are constantly seen in process of division, fuse or aggregate into plasmodia, which reach a large size in the spleen. From these again are given off flagellate forms which increase in size and become the ordinary adults.

Pseudomonas stewarti.‖—Dr. E. F. Smith gives the following description of *Pseudomonas stewarti* sp. n. isolated by Stewart from sweet corn. A motile rodlet with rounded ends, $0 \cdot 5 – 0 \cdot 9 \times 1 – 2\,\mu$; one polar flagellum; no spores observed; found in the vascular bundles of corn (*Zea mays*) associated with a destructive disease of which it is probably the cause; colour in the host-plant and in culture media yellow; aerobe and potential anaerobe; grows in all ordinary culture media with alkaline or acid reaction; growth favoured by cane-sugar, grape-sugar, and galactose; produces alkali; reduces litmus slowly; does not liquefy gelatin or blood-serum; grows well at 25°–30° C.; does not produce gas; is sensitive to light, but does not die out quickly.

* Rev. Suisse Zool., vi. (1899) pp. 557–636 (2 pls.).
† Comptes Rendus, cxxviii. (1899) pp. 1247–9 (1 fig.).
‡ Trans. Amer. Micr. Soc., xx. (1899) pp. 51–6 (1 pl.).
§ Proc. Roy. Soc., lxv. (1899) pp. 274–81.
‖ Proc. Amer. Assoc. Adv. Sci., xlvii. (1898) pp. 422–6.

Malaria Parasites.* — Dr. R. Ross, in a short account of the life-history of the parasites of malaria, points out that the youngest parasites exist as amœbulæ or myxopods within red corpuscles. In the course of a few days they become either sporocytes or gametocytes. The sporocytes are produced asexually, and contain spores which on maturation break through the red corpuscle and become disseminated in the plasma; each sporelet attaches itself to another corpuscle, and so on. The gametocyte may resemble a sporocyte in appearance, or be crescent-shaped. Further development is only attained in an intermediate host, and this is reached in the alimentary canal of certain suctorial insects, where they become endowed with sexual functions. The male gametocytes emit a variable number of microgametes, which seek the female gametocytes. These are motionless macrogametes. From the union of the two is produced a zygote, a round or oval cell 8–10 μ in diameter. In the body of the insect host the zygotes grow and undergo certain changes, becoming zygotomeres, then blastophores, and finally zygotoblasts. The latter are discharged into the insect's blood, and are then seen to be delicate flagellulæ or mastigopods, 12–16 μ in length. Eventually the mastigopods reach the salivary glands, where they accumulate in large numbers. During haustellation they escape from the gland, passing along the duct into the blood of a new vertebrate host. Apparently therefore the mastigopod is the amœbula or myxopod. Until the zygotoblast stage the various forms contain pigment-granules derived from the hæmoglobin of the red corpuscles.

For classification purposes, the author divides the family Hæmamœbidæ into two genera, one having four species, i.e. *Hæmamœba*, the other, *Hæmomenas*, only one.

In *Hæmamœba* the mature gametocytes are similar in form to the mature sporocytes before the spores have been differentiated. In *Hæmomenas* the gametocytes have a special crescent form.

The most common intermediary host is found to be *Anopheles claviger*.

Development of Malaria Parasites.†—The report of Prof. R. Koch, Prof. Kossel, and Prof. Pfeiffer, while containing little new except what relates to the vermiform stage, is useful, as it confirms and elaborates the work of others with regard to the life-history of the malaria parasites *Halteridium* and *Proteosoma*. The following is a summary of their development:—(1) Young parasite composed of chromatin nucleus and very scanty plasma; no nucleus. Lives in or on red corpuscles. (2) Adult composed of chromatin, pigment, and with relatively much increased plasma. From this point development may proceed in two ways. (3) *Endogenous*, i. e. in the body of the principal host. Simple division into numerous small particles which commence their cycle afresh, abandoning the pigment in the mother-cell. (4) *Exogenous*, i. e. in the body of the intermediate host (mosquito). Parasite leaves the blood-corpuscle, and can be differentiated into male and female. (5) Formation of spermatozoa and impregnation of female. (6) Conversion into vermiform bodies which (7) pass through the stomach walls and form coccidia-

* Nature, lx. (1899) pp. 322–4, 439.

† Zeitschr. f. Hygiene u. Infekt., xxxii. (1899). See Brit. Med. Journ., 1899, ii. p. 1039.

like spheres, in which (8) sickle-shaped bodies develope. (9) Passage of these into the poison-glands, and possibly into other organs. (10) Infection of principal host.

In human malaria the young parasites of tertian and quartan fevers resemble the adult parasites of tropical fevers so closely as to be indistinguishable.

The members of this group of infective Protozoa show such remarkable analogies in their developmental processes that what holds good for one almost certainly holds good for all. Hence if *Halteridium* forms vermiform bodies, it is tolerably certain that the human parasite does also.

Affinities of Siedleckia nematoides.*—Dr. A. Labbé discusses the affinities of this peculiar organism which Messrs. Caullery and Mesnil found as a parasite in *Scoloplos mülleri*. The discoverers suggested that it had affinities with *Amœbidium*, but this view is not shared by Dr. Labbé. As he has previously indicated, he holds that the Gregarines and allied forms illustrate a degeneration due to parasitism, and may have had a "mesozoic" origin. Their special mobility, the presence of highly developed myophane fibres, the tendency to have partitions and two or three nuclei, the mitotic division following dissolution of the nuclear membrane, and the peculiarities of reproduction (showing in the Coccidia, at least, phenomena resembling fertilisation in Metazoa), are among the facts which led him to the somewhat remarkable conclusion above indicated.

The discovery of *Siedleckia* appears to him to fill a gap. It is in many ways Gregarine-like, but it is multinucleate, and the nuclei are disposed in layers suggestive of epithelial structure. In short, Labbé suggests that *Siedleckia* is intermediate between Gregarines and the lower Mesozoa. The matter is complicated by the fact that Caullery and Mesnil have found in *Scoloplos mülleri* a new Orthonectid.

* Bull. Soc. Zool. France, xxiv. (1899) pp. 178–9.

BOTANY.

A. GENERAL, including the Anatomy and Physiology of the Phanerogamia.

a. Anatomy.

(1) Cell-Structure and Protoplasm.

Possible Function of the Nucleole in Heredity.*—Dr. H. H. Dixon offers a suggestion, founded on recent observations respecting the behaviour and development of the nucleus and of its constituent elements. It is that, "during the resting stage of the nucleus, the hereditary substance is distributed between the chromatin-threads and the nucleoles. This distribution is so arranged that the units of hereditary substance, idioblasts (Hertwig) or pangens (de Vries), which determine the attributes of the cell in which the nucleus is actually situated, are located in the chromatin-thread, while the inactive or dormant idioblasts are contained in the nucleole or nucleoles."

Reduction of Chromosomes.†—Prof. G. F. Atkinson describes two cases of this phenomenon which present important divergences from all the vegetable types hitherto known.

(1) *Arisæma triphyllum* (Araceæ). The process was followed out in detail in the formation of the pollen-mother-cells. The special peculiarity is that, while longitudinal division precedes transverse division of the chromosome, both divisions occur during the first or heterotypic division, and the real reduction follows soon after the pseudo-reduction in the heterotypic division. This has not previously been observed in plants.

(2) *Trillium grandiflorum* (Liliaceæ). In the same process the chromosomes retain their individuality through the daughter-nuclei from the anaphase of the first division to the prophase of the second division. There is no evidence of a longitudinal division during the daughter-nucleus stage.

(2) Other Cell-Contents (including Secretions).

Yellow Colouring Matters which accompany Chlorophyll.‡—Mr. C. A. Schunck finds, in all crude alcoholic extracts of healthy green leaves, two yellow colouring matters accompanying the chlorophyll—chrysophyll and xanthophyll; this latter (the term being used in a somewhat restricted sense) being the predominant one, and identical with the principal yellow colouring matter of faded autumn leaves. Other yellow colouring matters may also be present. Chrysophyll and xanthophyll each give a characteristic absorption spectrum in the violet and ultra-violet region; the former consists of three bands, the latter of four. Chlorophyll itself also gives three characteristic bands in the violet. Phyllocyanin and phylloxanthin have bands in identical positions with these three chlorophyll bands.

* Ann. of Bot., xiii. (1899) pp. 269–78.
† Bot. Gazette, xxviii. (1899) pp. 1–26 (6 pls.).
‡ Proc. Roy. Soc., lxv. (1899) pp. 177–86 (1 pl.).

Proteolytic Enzyme of Nepenthes.—Herr A. Hansen * calls attention to the fact that Czapek, in his notice of Vines's work on the proteolytic enzyme of *Nepenthes*, has ignored his own work on the subject (1885). He states that the products of digestion obtained by Vines and others are not pure substances.

To this F. Czapek † replies, and maintains that the results obtained by Vines are an advance on those previously recorded by Hansen.

Encapsuling of Starch-grains.‡—Dr. L. Buscalioni gives another example of this phenomenon, in the cortex of the root of *Juncus tenuis*. After giving in detail the result of microchemical investigations, he states that, as in the case of the seeds of *Vicia narbonensis*, under the influence of special factors not yet well determined, there may be formed, around starch-grains, a membrane of a mucilaginous character, possibly of a pectic-cellulose composition, analogous to that found by Rosanoff surrounding crystals of calcium oxalate.

Craterostigma pumilum.§—Prof. H. M. Ward and Miss E. Dale describe this rare plant from Somali-land, belonging to the Scrophulariaceæ. Its most remarkable characteristic is a red colouring matter of the roots, contained not in the cells, but in the intercellular spaces. The pigment appears to be present in the form of rounded non-crystalline granules, which may possibly be resinous, and which, in their microchemical reactions, most closely resemble the colouring matter in the flowers of *Aloë*. The authors regard it as a product of excretion.

Cane-sugar in Plants.‖—According to Herr E. Schulze, cane-sugar is widely distributed in the ripe seeds of plants, although often present only in small quantities. It occurs in the seeds of conifers. It is probably of importance as a reserve-material to be used in germination; but, since it increases as growth goes on, it must fulfil other uses as well. Accompanying the cane-sugar, other soluble sugars capable of inversion are also present, sometimes in large quantities.

Copper in Plants.¶—To the instances recorded of the occurrence of copper in a number of different plants, M. E. Heckel now adds *Quassia gabonensis*, where he finds an appreciable amount in the seeds.

(3) Structure of Tissues.

Growth of the Thickening-Ring in Dicotyledons. **—Rosseler, Mischke, and Raatz have already shown the incorrectness, with regard to Monocotyledons and Gymnosperms, of Sanio's "initial-theory," that, in a radial row of cambium-cells, only a single one, the "initial cell," gives off cells on the outside and the inside, while their daughter-cells, before their development into xylem- and phloem-elements, can divide at most only once. Herr M. Nordhausen now extends his observation

* Bot. Ztg., lvii. (1899) 2te Abt., pp. 267–9. Cf. this Journal, *ante*, p. 292.
† Tom. cit., p. 269.
‡ Malpighia, xiii. (1899) pp. 3–13 (1 pl.). Cf. this Journal, 1898, p. 207.
§ Trans. Linn. Soc. (Bot.), v. (1899) pp. 343–55 (2 pls.).
‖ Zeit. phys. Chem., xxvii. (1899) pp. 267–91. See Journ. Chem. Soc., 1899, Abstr. ii. p. 570.
¶ Bull. Soc. Bot. France, xlvi. (1899) pp. 42–3. Cf. this Journal, *ante*, p. 292.
** Beitr. z. wissensch. Bot. (Fünfstück), ii. (1898). See Bot. Centralbl., lxxix. (1899) p. 62.

to Dicotyledons, and asserts that in their cambium also there is no one cell which is distinguished from the rest by its greater or less capacity for division. There is a layer of meristematic cells corresponding to the meristem in the apex of a stem. The same law governs the growth of the meristem of the medullary rays. The author points out, moreover, that these observations are prejudicial to Krabbe's theory of "gliding growth."

Increase in Thickness of Palm-stems.*—Herr G. Kraus states that in *Oreodoxa regia* (in Java) there is, in the course of a few months, a quite appreciable increase of thickness in the whole of the stem. The zone of the trunk in which the greatest increase takes place appears to differ in different palms. He further asserts that this increase is not derived from a cambium layer, but to by far the greatest extent from a secondary increase of the original fundamental tissue and of the sclerenchyme of the vascular bundles. It is, in fact, comparable to the mode of growth of a leaf or of a fruit, rather than to that of the stem of Dicotyledons. It especially resembles the former in its more limited character.

Gum-canals of Carludovica.†—M. H. Micheels has studied the formation of the gum-canals in *Carludovica plicata*, belonging to the Cyclanthaceæ. They are of schizolysigenous origin. The root is entirely destitute of these canals. In the young leaf they occur only in the lower region of the lamina; in the adult leaf they are found in the sheath, the petiole, and the lamina. They are present also in the spathe and in the floral organs.

Water Storage in Senecio præcox.‡—Dr. J. W. Harshberger describes the peculiar structure of the stem and root of this plant growing on a lava-formation in Mexico. The stem possesses a very watery firm pith, a small cylinder of wood, and a wide cortex with chlorophyll and receptacles from which exudes a resinous or balsamic substance. The pith serves as a storage for water.

Fall of the Leaf and Cicatrisation of the Wound.§—According to M. A. Tison, the separating layer formed at the base of a leaf ready to fall does not always result from a secondary meristem; it is often composed of two or three layers of primary tissue. The detachment is frequently the result of a doubling of the wall between two layers of the separating tissue. A certain thickness of this wall, comprising the primary cell-wall and the adjacent secondary layers, becomes transformed into pecto-cellulose-mucilage, which swells and gelatinises. After this dissolution the cells are isolated from one another, their protoplasm being enveloped only by a thin internal membrane, the remains of the primitive wall. The cells of these two layers elongate towards one another, and, by their mutual pressure, rupture the vascular system, and detach the leaf. Cicatrisation may take place either by a sclero-suberous modification in the walls of one of the cell-layers of the cushion; or by the formation of a peridermal layer histologically re-

* S.B. phys.-med. Gesell. Würzburg, 1899, pp. 62–8.
† Bull. Soc. R. Bot. Belgique, xxxvii. (1898) C.R., pp. 95–100 (1 pl.).
‡ Contrib. Bot. Lab. Univ. Pennsylvania, ii. (1898) pp. 31–40 (2 pls. and 1 fig.).
§ Comptes Rendus, cxxviii. (1899) pp. 1530–2; cxxix. (1899) pp. 125–7.

sembling that of the stem; or by the formation of a sclero-suberous layer beneath the periderm. The only difference between leaves which wither on the tree and those which fall before withering, is the incomplete formation in the former case of the separating layer.

At the zone of the articulation of the petiole, the stereome of the vascular bundles is always wanting, the only lignified elements being the vessels. The xylem-fibres are wanting, and in most cases also the phloem-fibres. Cicatrisation is effected by a sclero-suberous modification of the existing cells similar to that of the fundamental tissue. The sieve-tubes are usually destroyed; the vessels are stopped by the production of a gum, or by thyllæ, most often by both.

The crystalliferous cells are never again septated; their walls undergo a sclero-suberous modification. The other isolated secreting cells undergo no change in the cushion. The branched laticiferous cells close up, before the fall of the leaf, by two septa, one above the separating layer in the petiole, the other below it, in the cushion.

Fall of the Leaves of Monocotyledons.* — M. E. Fouilloy finds that in certain genera of Orchideæ belonging to Tropical America—*Octomeria*, *Bulbophyllum*—with thick deciduous leaves, the region of the leaf where its detachment is effected becomes differentiated at an early period. Long before the period of the fall of the leaf, it is readily distinguished from the tissues which bound it as a layer still composed of very small cells which retain their cellulose character.

Anatomy of the Root and Stem of Chenopodiaceæ.†—M. G. Fron has studied the structure of the axial organs in various genera of Chenopodiaceæ. In the root he finds two modes of arrangement of the vascular bundles, symmetrical and asymmetrical; the latter resulting from an unequal development of the two primitive phloem-masses. This difference is correlated with a difference in the structure of the embryo. When, in the embryo, the radicle is not in contact with the cotyledons, the final structure of the root is symmetrical; when the radicle is in close contact with the cotyledons, the root is asymmetrical. The spiral arrangement of the vascular bundles cannot be taken as a generic character. The secondary formations are produced by a different mechanism in the root and in the stem of the same species. In the stem the course of the vascular bundles is sometimes straight, sometimes wavy. The passage from the root to the stem structure takes place at very different points in the hypocotyledonary axis.

Gall of Aulax Papaveris.‡—M. M. Molliard describes the deformations produced in the capsule of *Papaver Rhœas* and *dubium* by the larvæ of *Aulax papaveris*. In the centre of the capsule is a mass of white cellular tissue, containing well-defined cavities in which are found the larvæ. The placentæ are greatly hypertrophied. The hypertrophied tissue subsequently becomes differentiated into a nutrient tissue for the parasite, a sclerenchymatous ring, and a parenchyme. The ovules are completely atrophied. The peduncle of the diseased capsule is very liable to be attacked by *Peronospora arborescens*.

* Rev. Gén. de Bot. (Bonnier), xi. (1899) pp. 304–9 (6 figs.).
† Ann. Sci. Nat. (Bot.), ix. (1899) pp. 157–240 (6 pls. and 22 figs.).
‡ Rev. Gén. de Bot. (Bonnier), xi. (1899), pp. 209–17 (11 figs.).

(4) Structure of Organs.

External Resemblance of Species.* — Prof. T. Ito calls attention to the remarkable resemblance, both in the foliage and in the ripe fruits, of *Bischoffia javanica*, belonging to the Euphorbiaceæ, to *Turpinia pomifera*, a member of the Sapindaceæ, and suggests that the latter may obtain some advantage by imitating the appearance of a member of a poisonous order.

Dwarf Habit of Plants.†—M. P. Gauchery contributes an essay on "nanism" in the vegetable kingdom. His general conclusion is that the peculiarities which distinguish the external form and the internal structure of dwarf varieties of plants, are, like other characters, dependent on the environment, and are displayed more strongly in the vegetative than in the reproductive organs. A dwarf plant is not a miniature of the species with all the organs in the same proportion as in a plant of normal size.

Flower of Onagraceæ.‡—Herr A. Weisse has followed out in detail the development of the various whorls of organs in this order (*Œnothera biennis*), especially in reference to the formation of the inferior ovary. He concludes that the outer wall of the ovary is not a simple structure, but is composed, in its peripheral portion of the tissue of the axis, in its inner portion of the tissue of the carpels.

Amphicarpæa monoica.§ — Continuing her observations on this heterocarpous Leguminous plant with cleistoganous flowers, Dr. Adeline F. Schively gives a more detailed description of both the aerial and the subterranean legumes and seeds, and shows, from the result of experiments, that one can readily be converted into the other by altering the conditions. Although possessing absolutely the same structure in the young state, these organs present totally different morphological results according as they are exposed to light or to darkness. The great ease with which chlorophyll is replaced by anthocyan is one of the most remarkable results. It is probable that the purple aerial flowers represent the original type.

Placenta of Primulaceæ.‖ — From a detailed examination of its structure and development in several genera, M. L. Vidal has come to the conclusion that the placental column of Primulaceæ is composed of an axial portion and an appendicular portion. In the genera *Soldanella* and *Coris* the axial portion is elongated to an extraordinary extent, and probably serves to assist the pollen-tubes in their way to the ovules.

Mechanism of the Dehiscence of Anthers.¶ — A series of experiments made by Prof. S. Schwendener on the mechanical cause of the

* Bot. Centralbl., lxxix. (1899) pp. 33–5.
† Ann. Sci. Nat. (Bot.), ix. (1899) pp. 61–156 (4 pls. and 32 figs.).
‡ 'Beitr. z. Entwick.-gesch. d. Onagraceen-Blüte u.s.w.,' 1899 (9 pls.). See Bot. Centralbl., lxxix. (1899) p. 63.
§ Contrib. Bot. Lab. Univ. Pennsylvania, ii. (1898) pp. 20–30. Cf. this Journal, 1898, p. 320.
‖ Journ. de Bot. (Morot), xiii. (1899) pp. 139–46. Cf. this Journal, *ante*, p. 293.
¶ S.B. k. Preuss. Akad. Wiss., 1899, pp. 101–7 (2 figs.) Cf. this Journal, 1898, p. 560.

opening of anthers, supports the view of Leclerc du Sablon that the most important factor in the movements is the fibrous layer of the wall of the anther. This great capacity for contraction of the cell-wall is necessarily associated with a corresponding molecular structure.

Caryopsis and Endosperm of Grasses.* — Mr. L. H. Pammel states that there are wide differences in the structure of the fruit in the different tribes of grasses. The development both of the pericarp and testa varies greatly in different genera. The nucellus is never entirely absent, though often much compressed. An aleurone layer is also always present. The endosperm always contains protein, though much reduced in the starch-cells, except in the aleurone layer, where no starch occurs. The starch-cells next to the endosperm contain more protein than the interior of the endosperm. Oil is also present in small quantities.

Fasciation of Stems.†—Herr E. Küster has investigated the anatomical changes which take place in the fasciation of stems in woody plants,—*Ficus*, *Fagus*, *Quercus*, *Platanus*, and *Hedera*. The growth of the cambium is retarded by the pressure; in *Ficus* this is accompanied by increased activity of growth and cell-division in the primary cortex. In *Ficus stipularis* the parenchyme of the medullary rays becomes lignified. Portions of cambium always become enclosed in the cortex and bark. In *Hedera* closed cambium rings are sometimes formed round these inclosures.

Adventitious Buds of Trees.‡—M. C. de Candolle has established a constant difference between the normal and the adventitious buds of trees. The latter he states must be regarded as new individuals of the same species as the tree from which they spring, or as apogamic embryos. The first leaves of shoots from adventitious buds have all the characters of the young leaves of the species. This is illustrated in the two different kinds of leaf in *Eucalyptus globulus*. In the walnut the pinnæ of the young leaves are denticulate, while those of the adult tree are quite entire. In the horse-chestnut the first two leaves have the same form as those which succeed them, but always differ from them in the absence of intramedullary xylem in the large veins. The leaves of the hornbeam present a similar variation. In all these cases the first leaves from the adventitious buds resemble in form and structure the first leaves of the young plant.

Interfoliar Buds in Pinus.§—Mr. A. W. Borthwick states that pines possess four kinds of bud,—apical buds, whorl-buds (including dormant buds or cryptoblasts), interfoliar buds (brachyoblasts), and axillary buds in the axils of primary leaves in the young plant. The interfoliar buds, which are specially described, occur between the leaves at the apex of a branch of limited growth.

The same author finds,‖ in *Pinus Laricio*, "spurs" with indifferently 2, 3, or 4 leaves.

* Trans. Acad. Sci. St. Louis, viii. (1899) pp. 201–20 (3 pls.). Cf. this Journal, *ante*, p. 49.

† Pringsheim's Jahrb. f. wiss. Bot., xxxiii. (1899) pp. 487–512 (1 pl. and 3 figs.).

‡ Arch. Sci. Phys. et Nat., viii. (1899) pp. 100–1.

§ Trans. Bot. Soc. Edinburgh, xxi. (1899) pp. 154–6.

‖ Tom. cit., pp. 150–3 (1 pl.).

Morphological Origin of the Leaf.*—Dr. H. Potonié discusses the derivation of the highly organised leaf of the higher plants from the simplest possible organisms, and points out the important part played by Goethe's theory of metamorphosis in the elucidation of the complicated problems of vegetable morphology.

Leaves of Cupressineæ.†—M. A. Daguillon adduces additional instances in support of his statement that the structure of the primordial leaves of many Coniferæ—i.e. those which immediately succeed the cotyledons—is intermediate between that of the cotyledons and that of the mature leaves in the characters already stated. This is brought out especially by a detailed description in the cases of *Araucaria imbricata*, *Wellingtonia gigantea*, *Sequoia sempervirens*, *Cryptomeria japonica*, and *Taxodium distichum*, and of the genera *Cupressus*, *Chamæcyparis*, *Biota*, and *Thuja*.

Leaf-primordia of Linaria spuria.‡—Prof. S. Schwendener supports his theory of phyllotaxis, in reply to the objections of Vöchting, by the observation that, in the leaf-shoots of *Linaria spuria*, there is an actual contact between the primordia of the leaves. The same is probably also true of the axillary flowering shoots.

Stomates and their Subsidiary Apparatus.§—Herr M. Westermaier finds, in the guard-cells of stomates, two kinds of hinge, polar and dorsal hinges. The former, which have not previously been described, are important, and were found in a large number of Monocotyledons. In *Echeveria Scheideckeri* the pair of guard-cells is surrounded by three subsidiary cells; the latter have both dorsal and polar hinges, consisting of thin spots in the cell-wall. In *Peperomia magnoliifolia* the walls of the secondary cells are thin throughout. Polar hinges are especially characteristic of succulent plants. The thick-walled surroundings of the stomates in the Cacteæ are described. The author further discusses the relation to classification of the various forms of stomate.

Development of Hairs.‖—Herr W. Hirsch classifies the hairs of plants under three heads, according as their growth is basipetal, acropetal, or intercalary. The intercalary growth of hairs is uncommon, and may be combined with either of the other kinds. It occurs in *Polemonium cœruleum* and *Tragopogon floccosus*. The mode of development of the hairs by no means always followed the characters used in classification. This occurs especially with the Labiatæ.

Seedlings of Woody Plants.¶—Mr. F. Ramsley describes the structure and development of the seedling in a large number of woody plants belonging to many orders of Dicotyledons. As a general result he states that a knowledge of the shape and general structure of the coty-

* Naturwiss. Wochenschr., xiv. (1899) No. 35, pp. 405–15 (12 figs.).

† Rev. Gén. de Bot. (Bonnier), xi. (1899) pp. 168–204 (1 pl. and 9 figs.). Cf. this Journal, *ante*, p. 296.

‡ SB. k. Preuss. Akad. Wiss., 1899, pp. 94–100 (1 pl.).

§ 'Ueb. Spaltöffnungen u. ihre Nebenapparate,' 1899 (4 pls.). See Bot. Centralbl., lxxix. (1899) p. 20.

‖ Beitr. z. wissensch. Bot. (Fünfstück), iv. (1899) 1te Abt. See Bot. Centralbl., lxxix. (1899) p. 97.

¶ Minnesota Bot. Studies, 1899, pt. ii. pp. 69–136 (8 pls. and 23 figs.). Cf. this Journal, 1893, p. 62.

ledons does not help one to predict the character of the foliage-leaves. Broad generalisations in regard to the shape of the cotyledons in plant-families cannot be safely made without a considerable mass of data.

The hypocotyledonary and the epicotyledonary regions are, in their primary structure, essentially dissimilar. The epiderm of the hypocotyl is more often without trichome structures; the cortex is thicker, and is composed of larger cells; the endoderm is more distinct; the pith is smaller; the sclerenchyme is often less well-developed and differently arranged; there is very rarely a hypoderm. The distribution of starch is, as a rule, the same in both regions. As to the structure of the stele, there are in the hypocotyl usually four primary vascular bundles, occasionally a larger number. In the epicotyl the vascular bundles are from six to eight, or much more numerous.

Seedlings of Jatropha multifida and Persea gratissima.*—According to Mr. T. Holm the seedling of *Jatropha multifida* (Euphorbiaceæ) agrees with that of *Myristica Bicuhyba*, as described by F. Müller, in the remarkable peculiarity that the long hypocotyl raises the seed above the ground, and the cotyledons are provided with petioles of considerable length, and yet the cotyledons are entirely enclosed within the seed-coat, and fall off without being exposed to sunlight. In *Persea gratissima* (Lauraceæ) the first four leaves of the seedling are in opposite pairs, and have distinct petiole and laminæ, while the succeeding five or six leaves are almost scale-like, with no petiole or lamina, but are covered with silky hairs like the axis and the succeeding leaves when young.

Root-suckers of the Douglas Fir.†—Mr. F. H. Lamb notes the occurrence of root-suckers on the Douglas Fir, *Pseudotsuga taxifolia*, in the dense woods of western Washington. They are found only in the densest and moistest forests, and the plants arising from them are with difficulty distinguished from ordinary seedlings.

Podophyllum peltatum.‡—Mr. T. Holm describes in detail the structure of this N. American plant, which presents the following peculiarities. In germination the blades of the two cotyledons are borne upon long petioles, which are united together in their whole length so as to form a cylindrical tube. The plumule is very minute, and is seated at the bottom of the cotyledonary tube. During the first year of growth the cotyledons are the only assimilating organs. The internal structure, like that of some other Ranunculaceæ, resembles in some respects that of Monocotyledons, rather than that of ordinary Dicotyledons. The mestome bundles in the aerial stem are not arranged in concentric bands, but form three irregular bands, of which two are located in the pith. The leptome consists exclusively of sieve-tubes and their companion cells, the sieve-parenchyme being entirely wanting.

Anatomical Structure of the Leafless Vanillæ.§—M. E. Heckel has examined the structure of two leafless species of *Vanilla*—*V. Phalænopsis* and *aphylla*—and finds the anatomical characters to differ widely from those of the leafy species, presenting features not hitherto found in the

* Bot. Gazette, xxviii. (1899) pp. 60–4 (6 figs.). † Tom. cit., pp. 69–70.
‡ Op. cit., xxvii. (1899) pp. 419–33 (10 figs.).
§ Comptes Rendus, cxxix. (1899) pp. 347–9.

Orchideæ. They are characterised by the emission, when wounded, of an abundant pseudo-latex, white in *V. Phalænopsis*, colourless in *V. aphylla* and *planifolia*.

β. Physiology.

(1) Reproduction and Embryology.

Embryology of Rumex.* — Mr. B. Fink has studied this in two American species, *R. verticillatus* and *salicifolius*. The development of the megaspore corresponds to that in *Polygonum*. The archespore divides first into a tapete and sporogenous cell; the latter giving rise to four potential megaspores, one of which only is fertile, absorbing the other three. The development of the embryo-sac, the mode of impregnation, and the development of the embryo, present no special features. The definite (vegetative) nucleus does not divide till after impregnation.

Embryo-sac of Scilla and Lilium.†—Mr. R. E. B. McKenney has followed out the development of the embryo-sac in species of *Scilla* and *Lilium*. In the anaphase stage of the original division of the archespore nucleus, the number of chromosomes which enter into the formation of the daughter-nuclei is eight. All the divisions of the surrounding nucellar cells, and the first division of the archespore, show 16 chromosomes. It is therefore probable that this last division of the archespore is the reduction division. "In the development of its ovule, *Scilla* may be said to differ from most plants in having a second macrospore undergo partial germination. In those species which develope more than one embryo-sac, each embryo-sac is developed as a rule from a separate archesporium. In *Scilla* the rudimentary second embryo-sac is developed from the same archesporium as the normal embryo-sac. Commonly it is the lowest cell of the chain of archesporial daughter-cells which becomes the embryo-sac. In *Scilla*, however, the lowest cell of the chain forms the second rudimentary embryo-sac, while the normal embryo-sac is developed from the cell above this."

Embryogeny of the Balanophoraceæ.‡—Prof. R. Chodat and M. C. Bernard point out the different results arrived at by van Tieghem and Treub, and describe their own observations on *Helosis brasiliensis*. The structure described by van Tieghem as a placenta is regarded by them as an archesporial tissue. The archespore is remarkable from the size of its cells and the vigour of its nuclei; the embryo-sac appears to develope indifferently from any one of its cells; occasionally a second sac appears, more or less equivalent to the first. The primary nucleus divides into two; the upper one alone developing normally, while the lower one becomes rapidly atrophied; the former usually produces two synergids. The mother-cell of the endosperm is never the result of the fusion of two polar nuclei. At the moment when this nucleus divides, the egg-cell undergoes a change; its nucleus loses almost completely its chromatophily; from that time neither it nor the synergids can be detected; the endosperm finally completely fills up the embryo-sac. The embryo is very rudimentary, and appears to have originated from a cell of the endosperm. Directing spheres were observed, both in the

* Minnesota Bot. Studies (1899) pp. 137–53 (4 pls.).
† Contrib. Bot. Lab. Univ. Pennsylvania, ii. (1898) pp. 80–6 (1 pl.).
‡ Arch. Sci. Phys. et Nat. viii. (1899) pp. 92–4. Cf. this Journal, 1898, p. 555.

divisions of the nucleus during the formation of the pollen-cells, and in the division of the mother-nucleus of the endosperm.

Embryology and Formation of Endosperm in Taxus.* — Herr L. Jæger has followed out these processes in the yew. The following are the more important results. At an early stage the nucellar tissue contains, in addition to the nuclei, a number of minute sharply-defined bodies, which are stained blue by hæmalum, closely resembling the aleurone grains of the endosperm cells. The original embryo-sac-mother-cell was not detected; the embryo-sac is the result of the enlargement of the lowest of a row of cells derived from the original mother-cell. More than one embryo-sac was never observed. In the formation of the endosperm within the embryo-sac the nuclei always lie on the wall of the sac. The number of nuclei usually amounts to 256 when the formation of the cell-walls commences; this is followed by the formation of endosperm (the female prothallium) also in the interior of the embryo-sac. The formation of the archegones takes place while the endosperm is still rather small; they result from the enlargement of cells in the upper part of the endosperm, but subsequently occupy a lower position. They contain either one or two nuclei; the number subsequently increasing to four, five, or six, in addition to aleurone grains, starch, oil, and a small quantity of albumen.

The pollen-tubes enter the nucellar tissue when the embryo-sac is still very small. The ovum is simply a comparatively large nucleole, about double the size of the pollen-nucleus, although the amount of active nuclear substance is about the same in both at the period of impregnation. The impregnated ovum-cell lies in the lowest part of the archegone. Cell-formation does not commence until the number of nuclei amounts to 16 or 32.

The formation of the embryo is described in detail. It is common for several to be formed in consequence of the entrance of several pollen-tubes into the apical portion of the endosperm; but only one developes. At the time when the embryo has become an eight-celled body, the eight cells lying in two layers, the four cells of the upper layer elongate into embryonal tubes, the number of these tubes subsequently increasing to six or more. The true embryo is formed from these embryonal tubes, though they do not all take part in its formation.

The number of cotyledons is usually two, occasionally three.

(2) Nutrition and Growth (including Germination, and Movements of Fluids).

Localised Stages of Development in Plants and Animals.†—Starting from the laws that, in the young organism, stages are found, the equivalents of which are to be sought in the adults of ancestral types; and that in old age stages are found which are similar to stages found in the young; Mr. R. T. Jackson further propounds the following laws:—that, "Throughout the life of the individual, stages may be found in localised parts which are similar to stages found in the young, and the equivalents of which are to be sought in the adults of ancestral groups";

* Flora, lxxxvi. (1899) pp. 241–88 (5 pls.). Cf. this Journal, *ante*, p. 504.
† Mem Boston Soc. Nat. Hist., v. (1899) p. 89–153 (10 pls.).

and that "The equivalents of regressive or progressive localised stages are to be sought in the adults of regressional or progressional series of groups." A large number of illustrations are given, chiefly taken from the vegetable kingdom.

Influence of Static Electricity on the Direction of Roots.*—Experimenting on the roots of *Vicia Faba*, M. A. Letellier finds that positive static electricity exercises an influence on the direction of the primary and secondary roots opposite to that of the electric plate; but the action of negative static electricity is much less decided, scarcely perceptible on the primary roots; while the action on the secondary roots can be traced by a curve behind that which removes the roots from the negative plate.

Dissemination of the Seeds of Razoumofskia.†—Prof. D. T. MacDougal describes the structure of *Razoumofskia* (*Arceuthobium*) *robusta*, belonging to the Loranthaceæ, parasitic on *Pinus ponderosa*, and characterised by the almost entire absence of chlorophyll, and by the leaves being reduced to minute bracts. The berry-like fruit has a peculiar expulsion apparatus by which the seeds are thrown out to a considerable distance without external agency. The seed has the form of a rifle bullet, conical at the basal end and truncate at the apical end, with a general cylindrical outline. Its expulsion is effected by the rapid swelling of a layer of globoid cells with thick mucilaginous contents immediately surrounding the seed; this causes the rupture of a scission-layer at the base of the fruit, which causes the seed to be thrown out to a distance of 2 or 3 metres. The seeds can germinate only on the young shoots of the pine, to which they become attached by the mucilage which they carry with them.

Germination of Crinum Macowani.‡—Dr. J. H. Wilson describes the mode of germination of the seeds of this plant, which presents several peculiarities. The transference was demonstrated of stored food-material from the fleshy endosperm of the seed to the equally fleshy tissues of the bulb.

Effect of various Substances on the Respiration and Assimilation of Submerged Plants.§—From experiments on the influence on the growth of *Elodea canadensis* and *Myriophyllum verticillatum* of a variety of organic and inorganic substances, Herr B. Jacobi adduces the general law that the assimilation of aquatic plants is lowered in intensity, while the respiration is increased to an extent varying with the substance employed.

(3) Irritability.

Geotropism of Roots.‖—Herr M. Wachtel has repeated Czapek's experiments ¶ on the geotropism of roots, and has arrived at a very different result, which altogether negatives the theory of a "brain function" of roots. He finds geotropic sensitiveness to be by no means a special

* Bull. Soc. Bot. France, xlvi. (1899) pp. 11–23.
† Minnesota Bot. Studies, 1899, pp. 169–73 (2 pls. and 1 fig.).
‡ Trans. Bot. Soc. Edinburgh, xxi. (1899) pp. 211–6 (1 pl.).
§ Flora, lxxxvi. (1899) pp. 289–327.
‖ Schrift. Naturf.-Gesell. Odessa, xxiii. (1899) (Russian). See Bot. Ztg., lvii. (1899) p. 227.
¶ Cf. this Journal, 1895, p. 454.

property of the root-tip. Under normal conditions the apical region itself, for a short distance, does not exhibit any considerable geotropic sensitiveness; but this is the result of the tip being kept in passive equilibrium by the curvature of the more rapidly growing zone immediately behind the apex.

Expenditure of Labour in Geotropical Curvature.* — Herr P. Meischke has endeavoured to solve the problems connected with this subject in the cases of hypocotyls, epicotyls, and leaf-cushions. The results are given in a number of tables specifying the plant on which the experiments were made.

(4) Chemical Changes (including Respiration and Fermentation).

Synthesis of Albumen in Green Phanerogams.†—The chief results of a series of observations by Herr B. Hansteen on *Lemna minor*, *Vicia Faba*, and *Ricinus communis*, are as follows. Light plays no direct part, at least usually, in the synthesis of albumen in the green parts of flowering plants. Under favourable conditions of growth, albumen is formed in them without access of light, and at any time of the year. The production depends, however, on the presence at the time of special carbohydrates. The amides, amido-acids, and other nitrogenous compounds are not indifferently of use for the formation of albumen. The substance best adapted for this purpose is urea, which is rapidly transformed into albumen if accompanied in the cell by either cane-sugar or grape-sugar.

Alcoholic Fermentation without Yeast-cells.‡—Herren E. Buchner and R. Rapp draw the following conclusions from numerous experiments.

(1) When yeast which has been well triturated with kieselguhr and quartz-sand, is fractionally filtered under a pressure of 60 kilos per square cm., the liquid which runs through first is far less active than the later fractions, the most active portion being obtained by a second trituration and filtration without the addition of more water. From 1200 grm. of yeast with the gradual addition of 65 ccm. of water, 730 ccm. of active extract may be obtained. When, however, the extract is filtered through biscuit porcelain, the first 20 ccm. are much more active than any of the subsequent fractions.

(2) Fermentation takes place equally readily with solutions containing from 15 to 30 per cent. of sugar; in such case toluene is added, and the temperature kept at 23°. When sugar is not present, very little fermentation takes place, the maximum amount of carbonic anhydride evolved from 20 ccm. of extract being, after 40 hours, 0·06 grm., and after 88 hours 0·1 grm.

(3) Starch itself is not fermented by the extract, but "soluble starch" and dextrins of various origins are readily fermented.

(4) Glucose and fructose are fermented at practically the same rate as one another, both by yeast extract and by fresh Münich bottom yeast. This conclusion is, however, not in accord with statements made by other authorities.

* Pringsheim's Jahrb. f. wiss. Bot., xxxiii. (1899) pp. 337–67.

† Tom. cit., pp. 417–86 (2 figs.).

‡ Ber. Deutsch. Chem. Gesell., xxxii. (1899) pp. 2086–94. See Journ. Chem. Soc., 1899, Abstr., ii. p. 606. Cf. this Journal, *ante*, p. 56.

(5) The previous irregularities noticed on the addition of potassium arsenite to the yeast extract are probably to be explained by the proteids in the extract protecting the zymase from the action of the arsenite; as it has been found that the dilution of the extract with water, in the presence of 2 per cent. of arsenite, practically stops fermentation, whereas dilution with blood-serum or liquids rich in proteids, or even sugar solution, in the presence of the same amount of arsenite, retards the fermentation to a slight extent only. Glucose can also be fermented to a certain extent by yeast extract in the presence of arsenite.

γ. General.

Origin of the Leafy Sporophyte.*—Prof. J. M. Coulter discusses the difficult question of the phylogeny of the leafy sporophyte. The tendency of his paper is to suggest that the Pteridophyta may have had an entirely different phylogenetic origin from the Bryophyta. "The polyphyletic origin of similar structures," e.g. the archegone of Mosses and of Ferns, "and of similar groups, makes the problems of phylogeny immensely more complex, but is probably much more consistent with the facts."

Effect of Arsenic on Plants.†—M. R. Bouillac enumerates a number of fresh-water algæ which can absorb a certain amount of arsenic acid in the form of arseniates without injury, these salts partially taking the place of phosphates. The species referred to are *Ulothrix tenerrima*, *Protococcus infusionum*, *Dactylococcus infusionum*, and *Stichococcus bacillaris*. With *Schizothrix lardacea* arsenic acid seems even to have a more favourable influence on the growth than phosphoric acid.

Action of Roots on Granite.‡—Sig. F. Sestini finds that the roots of many plants, especially those of Leguminosæ and Gramineæ, have a powerful decomposing effect on felspar, assimilating the alkaline bases, and all the ingredients which serve for the nutriment of the plant, leaving behind hydrated aluminium silicate. A similar part is also probably played by the microbes of the soil.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Prothallium of Lycopodium clavatum.§—Mr. W. H. Lang describes the hitherto unknown prothallium of this club-moss. It is a nearly flat plate of tissue with numerous rhizoids, its structure closely resembling that of *L. annotinum*. Of seven prothallia examined, six were female and one male. No archegones were found on the latter; but on two of the female prothallia a few antherids were seen. The archegones and antherids were both confined to the upper surface of the prothallium; each organ is developed from a single superficial cell. In the young plant no structure was recognised comparable to the protocorm of *L. cernuum*. The large foot persists for a considerable time after the

* Bot. Gazette, xxviii. (1899) pp. 46–59.
† Ann. Agronomiques, 1898, pp. 561–602. See Bull. Soc. Bot. France, xlvi. (1899) p. 64.
‡ Atti Soc. Tosc. Sci. Nat., Proc. Verb., xi. (1899) p. 138.
§ Ann. of Bot., xiii. (1899), pp. 279–317 (2 pls.).

prothallium has disappeared. The cells of the prothallium are infested by an endophytic fungus.

The author then discusses the comparative structure of the prothallia of species of *Lycopodium* at present known, and dissents from the view of Bruchmann * that it should, on this ground, be split up into a number of distinct genera.

Leptosporangiate Ferns.† — In a scientific classification of the Filices, Prof. F. O. Bower advocates the use of characters derived from the sporophyte in preference to those derived from the gametophyte. The characters regarded as of the greatest importance are :—(1) The relative time of appearance of sporanges of the same sorus ; (2) Certain details of structure of the sporange, including its stalk ; (3) The orientation of the sporanges relatively to the whole sorus ; (4) The potential productiveness of the sporange as estimated by its spore-mother-cells, and the actual spore-output. On this basis he classifies the homosporous ferns as follows :—

Simplices	Marattiaceæ ..	Eusporangiate
	Osmundaceæ	Leptosporangiate
	Schizæaceæ	
	Gleicheniaceæ	
	Matonineæ	
Gradatæ	Loxsomaceæ	
	Hymenophyllaceæ	
	Cyatheaceæ	
	Dicksonieæ	
	Dennstaedtiinæ	
Mixtæ	The bulk of the Polypodiaceæ	

The Simplices have all the sporanges of the sorus formed simultaneously; the Gradatæ have them disposed in basipetal succession; the Mixtæ have sporanges of different ages intermixed. The Simplices and Gradatæ have an oblique annulus (where definitely present); the Mixtæ (with very few exceptions) have a vertical annulus. None of the Mixtæ have a higher spore-output per sporange than 64; but this number is exceeded by some of the Gradatæ, and large numbers are the rule in the Simplices (*Hymenophyllum tunbridgense* may have over 400). The Simplices and Gradatæ have relatively short thick stalks; the Mixtæ have usually long and slender stalks. The orientation of the sporange in the Simplices and Gradatæ is usually definite ; in the Mixtæ it is indefinite. The receptacle is often elongated in the Gradatæ, but not in the Simplices or Mixtæ. It is claimed that a biological advantage would be gained by the suggested transitions.

The proposed basis would not bring about any great change in the current classification of Leptosporangiate Filices. If the suborders Osmundaceæ, Schizæaceæ, and Marattiaceæ are transferred from the end to the beginning, we have the Simplices. The Gradatæ include the Cyatheaceæ, Dicksonieæ (excluding *Dennstædtia*), Hymenophyllaceæ, and Loxsomaceæ.

* Cf. this Journal, *ante*, p. 302.
† Proc. Roy. Soc., lxv. (1899) pp. 96-9; Ann. of Bot., xiii. (1899) pp. 320-4.

Production of Apospory in Athyrium filix-femina var. uncoglomeratum.*—Mr. F. W. Stansfield treated this fern, which is apparently barren, by cutting off parts of immature fronds, and allowing them to expand during eighteen months in a uniformly humid atmosphere. The result was the production, in the ultimate divisions, of a meristematic tissue, which gave rise to (1) gemmæ or bulbils, (2) prothallia, producing both apogamous buds and ordinary sexual axes of growth. One of the prothallia bore both archegones and antherids. The primary fronds produced by apospory readily gave rise to fresh aposporous growths; this feature being characteristic of aposporous ferns in general. The author suggests, as a consequence derived from this fact, that apospory is an atavic character in ferns.

Leaves of Ferns.†—An exhaustive examination of the structure of the leaves of ferns belonging to all the principal genera induces M. P. Parmentier to classify those which belong to the flora of France in the following groups:—A. Mesophyll composed of a single layer of cells; no stomates; hairs stellate (*Hymenophyllum* and *Trichomanes*). B. Mesophyll composed of several layers of cells; hairs multicellular, unicellular or 0; (*a*) vascular bundle of the petiole single, of uniform thickness, arched, then curved towards the plane of symmetry and ending in loops (*crochets*); secreting canals conspicuous (*Osmunda*); (*b*) vascular bundles more than three, not arched, forming, with the brown sclerenchyme, the figure of the imperial eagle of Austria (*Pteridium*); (*c*) vascular bundles one or two, without small inferior bundles (18 out of the 26 genera); (*d*) two thick vascular bundles, in addition to 1–5 small inferior bundles, all arranged in an arc (*Blechnum*, *Polystichum*, *Aspidium*, *Polypodium*).

Matonia.‡—Mr. A. C. Seward discusses the structure and affinities of this aberrant genus of Malayan ferns, consisting of only two species. In structure it presents points of agreement with several families of ferns, on the whole approximating more closely to the Cyatheaceæ than to any other family; but the peculiarities are such as to justify the placing of *Matonia* in a separate division of the Filices.

Rejuvenescence of the Adventitious Buds of Cystopteris bulbifera.§—In addition to the ordinary adventitious buds, Herr E. Heinricher finds that this fern produces "regenerating buds" (*Regenerationsknospen*), which also have a strong faculty of rejuvenescence. They are always produced above the point of insertion of a scale (*Niederblatt*), and on its upper surface. These do not, like the ordinary adventitious buds, give rise to fleshy scales containing food-reserves, but at once to assimilating leaves.

Development, Structure, and Affinities of Equisetum.‖—Mr. E. C. Jeffreys has investigated the development of tissues and organs in several species of *Equisetum*. He distinguishes, in Vascular Crypto-

* Journ. Linn. Soc. (Bot.), xxxiv. (1899) pp. 262–8 (4 figs.).
† Ann. Sci. Nat. (Bot.), ix. (1899) pp. 289–361 (71 figs.).
‡ Ann. of Bot., xiii. (1899) pp. 319–20; Proc. Roy. Soc., lxiv. (1899) pp. 439–40.
§ 'Ueber die Regenerationsfähigkeit d. Adventivknospen v. Cystopteris bulbifera,' 1899, 6 pls. See Bot. Centralbl., lxxix. (1899) p. 16. Cf. this Journal, 1896, p. 654.
‖ Mem. Boston Soc. Nat. Hist., v. (1899) pp. 155–88 (5 pls.).

gams and Phanerogams, two primitive types of vascular axes,—the *prostelic* type, consisting primarily of a single concentric bundle, and the *siphonostelic*, in which the vascular tissue forms, from the outset, a bundle-tube. These latter are again distinguished into *phyllosiphonic* and *cladosiphonic*; in the former the continuity of the vascular bundle is interrupted by lacunæ occurring above the points of exit of the leaf-traces; in the latter the lacunæ occur above the traces of the branches. The archegone of the Equisetaceæ resembles that of the isosporous Lycopodiaceæ in being uniformly without a basal cell, which is invariably present in the archegone of the isosporous Filicales. Another agreement with Lycopodiaceæ is the fact that both shoot and root originate from the upper (epibasal) region.

As a general conclusion, the Equisetales appear to be related to the Lycopodiales rather than to the Filicales, especially in the following points:—gametophyte with fleshy vertical axis and thin lateral lobes; archegone without a basal cell and with vertical division of the neck-canal-cell; root and shoot epibasal in origin; small leaves and strobili; cladosiphony.

As regards fossil forms, the Sphenophyllaceæ must be regarded as the protostelic ancestors of the Equisetales, agreeing with them closely in all particulars except the structure of the stele.

Muscineæ.

Apical Growth, Phyllotaxis, and Origin of the Branches in Mosses.*—Herr C. Correns adds two more examples to those already known of the apical cell in Mosses dividing into two instead of three segments. In other Mosses this also occurs occasionally on special branches. The permanent phyllotaxis is ascribed by the author to secondary lateral displacement of the segments, resulting in a mode of torsion which he terms "apical torsion." It appears to be dependent on the supply of light. The origin of the branches in acrocarpous and pleurocarpous mosses is next discussed. In many cases the lateral branches arise at regular intervals determined by the number of divisions in the apical cell; while in other cases there are a large number of barren segments between two branches. Species of the same genus present no uniformity in this respect. This also appears to be to a certain extent dependent on light.

Classification of Hypnaceæ.†—Herr G. Roth proposes to break up the Hypnaceæ into five distinct orders, viz.:—(1) *Isotheciaceæ*, with four groups,—Lescuræeæ (*Lescuræa*); Cylindrotheciæ (*Platygyrium*, *Pylaisia*, *Cylindrothecium*; Orthotheciæ (*Orthothecium*); Isotheciæ (*Isothecium*, *Homalothecium*). (2) *Brachytheciaceæ*, with two groups:—Brachystegiæ (*Camptothecium*, *Ptychodium*, *Brachythecium*, *Scleropodium*); Eustegiæ (*Bryhnia*, *Rhytidium*, *Myurium*, *Eurhynchium*, *Rhynchostegium*, *Rhynchostegiella*). (3) *Amblystegiaceæ* (*Amblystegium*, *Cratoneuron*, *Campylium*, *Drepanocladus*, *Calliergon*). (4) *Hypnaceæ*, with two groups:—Plagiotheciæ (*Plagiothecium*, *Isopterygium*, *Rhaphido-*

* 'Ueb. Scheitelwachsthum, Blattstellung, u. Astanlagen d. Laubmoosstämmchens,' Berlin, 1899, 28 pp. and 8 figs. See Bot. Ztg., lvii. (1899) 2[te] Abt., p. 241.

† Hedwigia, xxxviii. (1899), Beibl., pp. 3–8.

stegium); Hypneæ (*Heterophyllon, Drepanium, Ctenidium, Ptilium, Limnobium, Chrysohypnum, Hypnum, Hyocomium, Hylocomium*). (5) *Dendroideaceæ*, with three groups:—Cryptocarpæ (only exotic species); Orthocarpæ (*Climacium*); Camptocarpæ (*Thamnium*). The exotic Hypopterygiaceæ form an additional order.

Algæ.

Iodine in Algæ.*—According to M. A. Gautier, the average proportion of iodine in seaweeds is about 12 mgrm. per 100 grm. in the fresh, 60 mgrm. per 100 grm. in the dried plant. He finds the same element to be invariably present in fresh-water algæ belonging to all the different classes, though in much smaller quantities, the proportion varying between 0·25 and 0·40 mgrm. per 100 grm. in the dried plant. It was found in *Ulothrix dissecta, Cladophora fracta, Nostoc fragile, Protococcus pluvialis, Batrachospermum* sp., and the algal element of *Peltigera*; also in *Beggiatoa*. In the other species of Fungi and Schizomycetes examined, iodine was either entirely wanting (diphtheria bacillus), or present only in exceedingly minute quantities (tetanus bacillus, *Agaricus campestris, Boletus edulis, Cantharellus cibarius*).

Gigartina.†—Mary E. Olson has studied the structure of this genus of Florideæ from an undescribed species growing near Washington, U.S.A. The tissue of the holdfast (hapter) is characterised by cells having a quadrilateral outline, arranged in approximately regular rows extending vertically through it. In the pith there is an intimate protoplasmic connection between the contents of neighbouring cells. The cystocarp is compound, and the spores are aggregated into distinct groups. The cystocarps are constantly infested with the fronds of another small epiphytic alga. Nematheces were observed in one instance.

Constantinea.‡—Mr. E. M. Freeman describes the structure of this genus of Florideæ, of which he considers that all the alleged species should be reduced to one, *C. rosa-marina*. The cells of the intermediate area of the frond are packed with florideæ-starch grains, and these cells communicate with one another by protoplasmic connections, as also do those of the cortical area of the stipe. Tetraspores are known in only one sub-species, and are lodged in nematheces. Imbedded in the cortical tissue of the frond are numerous green spherical bodies which are endophytic algæ, probably *Chlorochytrium inclusum*.

Actinococcus and Phyllophora.§—Dr. O. V. Darbishire now accepts Schmitz's view (in opposition to his own previous conclusion) that the so-called nematheces of *Phyllophora Brodæi* are in reality those of a parasitic alga, *Actinococcus subcutaneus* (Lyngb.) K. Rosenv. (*A. roseus* Ktz.). The following is given as the diagnosis of the genus *Actinococcus*:—Thallus parasitic on other Florideæ, the vegetative portion consisting of filaments branching in the interior of the host-plant (intra-

* Comptes Rendus, cxxix. (1899) pp. 189-94.
† Minnesota Bot. Studies, 1899, pp. 154-68 (2 pls.).
‡ Tom. cit., pp. 175-90 (2 pls.).
§ Ann. of Bot., xiii. (1899) pp. 253-67 (1 pl. and 7 figs.). Cf. this Journal, 1894, p. 484.

matrical portion), and fertile filaments forming a cushion of parasitic tissue on the external surface of the host (extramatrical portion of the thallus); antherids and procarps unknown; tetraspores formed by cruciate division in radially disposed rows of tetrasporanges.

Fertilisation of Batrachospermum.*—From an examination chiefly of a species from the Cameroons, *B. Bohneri*, Herr W. Schmidle has come, on several points, to different conclusions as to the mode of fertilisation in *Batrachospermum* from those of Davis.† The trichogynes occur at the ends of branches which are readily distinguished from the other branches of the plant. Their form varies greatly in different species. There is never in them any indication of a nucleus before impregnation. At the apex of the trichogyne is a cap of mucilage, which finally completely envelopes the fertilising spermatia (pollinoids), upon which the trichogyne exercises a powerful attracting force. In the species examined more than one pollinoid is absorbed by the trichogyne. Each pollinoid contains almost invariably two nuclei. When the pollinoid puts out its conjugating tube which enters the trichogyne, the anterior nucleus passes into the trichogyne, usually followed by the posterior one. Although the process was not actually observed, the author has no doubt that the actual process of impregnation consists in the fusion of one of the nuclei of the pollinoid with the nucleus of the carpogone.

Germination of the carpospores frequently takes place while they are still attached to the glomerule. The position and structure of the hairs varies in different species of *Batrachospermum*, and may be conveniently used as a specific character.

Fertilisation and Development of the Oospore in Œdogonium.‡—Prof. A. N. Berlese has followed out these processes in the case of *Œ. vesicatum*, in which the production of "oospores" has been stated to take place parthenogenetically. The author asserts that this is not the case, antherids and antherozoids being formed on special filaments distinct from those which bear the oogones. The antherozoids, escaping from the antherid, reach the orifice of the oogone; the anterior extremity only of the antherozoid enters the oogone, and comes into contact with the oosphere. Its nucleus passes, with the cytoplasm, into the oosphere, and fuses with its nucleus in a true act of fecundation.

Nereocystis.§—Prof. C. MacMillan gives an account of the structure of this gigantic seaweed, belonging to the Laminariaceæ, the frond of which may attain a length of 100 metres, including the stipe. The large pneumatocyst or swim-bladder originates as a swelling in the stipe just below the lamina; it is retort-like in form, and may attain a length of 2–3 metres. In the stipe is a zone of sieve-tubes, which ultimately become extremely slender, and present somewhat the appearance of a thermometer-tube. The so-called trumpet-hyphæ the author believes to have a different origin from the sieve-tubes. The splitting of the lamina commences with the deliquescence of a single row of cortical cells immediately below the epiderm.

* Bot. Ztg., lvii. (1899) 1[te] Abt., pp. 125–35 (1 pl. and 1 fig.).
† Cf. this Journal, 1896, p. 333.
‡ Riv. Patol. Veg., vii. (1899) pp. 153–66 (2 pls.).
§ Bull. Torrey Bot. Club, xxvi. (1899) pp. 273–96 (2 pls.).

Abnormal Conjugation in Spirogyra.*—Mr. R. A. Robertson finds, in an undetermined species of *Spirogyra*, that conjugation may occur between one male and two female cells, while that between one male and several female filaments is very common. No distinction could be detected in the diameter of the filament or in the size of the cells between male and female filaments. In some cases a zygospore was found stretching from one cell to another through the conjugating tube.

Variation in Desmids.†—In an exhaustive paper on this subject, Mr. G. S. West shows that the Desmidieæ are morphologically specialised, and exhibit a marked pattern and symmetry of form, major and minor symmetries being recognisable in many species. A summary is given of all that is at present known concerning the variation in the cell-contents and in conjugation, and reference is made to the variability of the pyrenoids and to the moving corpuscles in *Closterium*. The author's conclusions may be summed up as follows:—

(1) The structure of the cell-contents is one of the most constant features exhibited by a species, but is one of little value in classification. (2) The outward form of the cell, as seen in front view, varies within certain limits which are usually very small, but which may in exceptional cases be considerable. The form of the vertical view is, as a rule, a more constant feature than the form of the front view. (3) The ornamentation of the cell-wall is relatively constant, being always arranged according to a definite law, which is only transgressed by variations in one or more of the individual component groups which constitute the pattern of arrangement. (4) The prolific growth and rapid division of immense numbers of desmids have a tendency to produce variations from the typical forms. (5) Slight changes in the conditions of environment cannot affect the characters of a species unless they act for long periods of time.

Glœoplax, a new Genus of Chætophoraceæ.‡—Among a number of Algæ from the elevated moors of Prussia, Herr W. Schmidle describes, under the name of *Glœoplax Weberi* g. et sp. n., one which forms soft expanded hyaline unilamellar discs on the surface of *Sphagnum*-leaves, in which are imbedded cells containing chlorophyll; filaments are put out from the margin of older plants. The green cells contain one or more parietal chlorophyll-discs, small starch-grains, a nucleus, but no pyrenoid. Swarmspores are formed in the round erect cells of mature plants, one in each cell. They develope into filaments of loosely attached cells imbedded in mucilage. From the absence of pyrenoids the author concludes that *Glœoplax* is not a palmella-condition of *Stigeoclonium*, *Chætophora*, or any allied genus. The young cells are about 5 μ in diameter, and 2–4 times as long as broad; older cells round, and 8–10 μ in diameter.

Fossil Dasycladaceæ.§—Herr G. Steinmann describes a number of fossil algæ belonging to this family, from the upper Cretaceous series

* Trans. Bot. Soc. Edinburgh, xxi. (1899) pp. 185–91 (2 pls.). Cf. this Journal, *ante*, p. 418.
† Journ. Linn. Soc. (Bot.), xxxiv. (1899) pp. 366-416 (4 pls. and 4 figs.).
‡ Hedwigia, xxxviii. (1899) pp. 159–62 (5 figs.).
§ Bot. Ztg., lvii. (1899) 1te Abt., pp. 137–54 (21 figs.).

of Mexico. They belong to the genera *Triploporella*, *Linoporella* g. n., and *Neomeris*, and are frequently in a very good state of preservation. From the fact that, with the exception of *Triploporella*, all the pre-tertiary Dasycladaceæ belong to the *Dasycladus*-type, the author derives the conclusion that this is the older type, from which the *Acetabularia*-type is descended.

Unicellular Colonial Algæ.*—In an important contribution to our knowledge of colony-forming algæ, Herr G. Senn treats of the genera *Cœlastrum*, *Scenedesmus*, *Dictyosphærium*, and *Oocardium*, from both a structural and a physiological point of view.

Cœlastrum. This genus is described as being composed of spherical or polygonal cells, with a chlorophyll-green bell-shaped chromatophore, a pyrenoid, and a starch-envelope. In the centre is the nucleus containing a single nucleole. Reticulate strings of protoplasm lie on the cell-wall, isolated strings crossing the cell-cavity. Multiplication takes place by repeated bipartition into immotile daughter-cells, until the number amounts to thirty-two. The membrane of the mother-cell then bursts into two halves which still remain connected, compound cœnobes being thus formed. When the supply of oxygen is deficient, spherical cœnobes are formed, the cells being united together by a mucilaginous layer. With deficient nutriment the cells pass into a resting condition, characterised by the formation of a reddish-yellow oil. As regards its systematic position, the author regards *Cœlastrum* as a typical member of the Pleurococcaceæ, rather than as nearly related to *Pediastrum* and the Hydrodictyaceæ. The genus consists of six species, the diagnoses of which, with their rather extensive synonymy, are given, and the structure and life-history of three described in detail.

In *Dictyosphærium pulchellum* no cellulose could be detected in the cell-wall. The jelly is not an amorphous product of the swelling of the mother-cell, but a distinct substance of evident rod-structure excreted from the cell, inducing the arrangement of the cells in colonies of definite form. No formation of resting cells or of swarm-spores could be established.

Oocardium. This genus belongs not to the Tetrasporeæ, but to the Desmidiaceæ, and must be placed near *Cosmocladium* and *Cosmarium*. The cells are divided into two halves by a shallow constriction. The valve-side is obovate; the girdle-side has an obcordate appearance on its broader side; on the narrower side it presents the appearance of a slightly constricted *Cosmarium*. It forms calcareous incrustations, within which the amorphous jelly takes the form of stalks.

The formation of colonies may take place in these algæ in five ways:—(1) by adhesion; (2) through union by remains of the mother-cell-wall; (3) by the excretion of jelly; (4) by the association of free swarm-cells; (5) by protoplasmic connections from cell to cell.

While not going so far as Chodat in his view of the polymorphism of algæ, the author asserts that all the three species of *Cœlastrum* examined by him may originate from single cells which are indistinguishable from the spherical Protococcoideæ.

* Bot. Ztg., lvii. (1899) 1te Abt., pp. 39–104 (2 pls. and 39 figs.).

Fungi.

Apodya lactea.*—Mr. R. Turnbull finds this fungus, belonging to the Saprolegniaceæ, in a polluted affluent of the Spey, and regards it as always an index of pollution in the water. He states that the branching is always lateral, and not dichotomous as usually stated; that the zoosporanges are developed as terminal shoots, and that the zoospores always germinate within the sporange.

Parasitic Fungi.—Herr P. Magnus † gives a review of the species of *Microsphæra*, and of the characters which distinguish it from *Erysiphe*, and describes as *M. Caraganæ* sp. n. the species parasitic on *Caragana arborescens*.

Herr H. Boltshauser ‡ describes a hitherto unknown parasitic fungus *Ascochyta Juglandis* sp. n., which produces hard round spots on the leaves of the walnut.

Herr H. O. Juel § identifies *Puccinia Polygoni vivipari* with *Æcidium Angelicæ*, and gives a *résumé* of the æcidia parasitic on various species of Umbelliferæ.

Herr P. Sorauer ‖ describes the various diseases caused by parasitic fungi in the species of *Dianthus* which grow in Germany.

Mr. A. P. Anderson ¶ has found a new species of *Tilletia*, parasitic on the rice-plant, the first smut reported on the rice in America.

Mr. A. J. Grant ** describes a little known mildew of the apple, *Sphærotheca Mali*, which attacks the apple-tree in North America.

Herr F. Noack †† finds the following species parasitic on the vine in Brazil:—*Peronospora viticola*, *Cercospora viticola*, *Oidium Tuckeri*, *Glœosporium ampelophagum*, *Melanconium fuligineum*, and a new species of Uredineæ, *Apiosporium brasiliense*.

Under the name *Septoria Azaleæ* sp. n., Dr. P. Voglino ‡‡ describes a fungus which attacks *Azalea indica*, causing the withering and subsequently the fall of the leaves.

A parasitic fungus which attacks the roots of *Viola tricolor* is described by Dr. A. N. Berlese,§§ under the name *Cladochytrium Violæ* sp. n.

Analogy of Nectria with the Parasitic Fungus of Human Cancer.‖‖—M. Bra has made some remarkable observations on the analogies presented by the cultures of *Nectria ditissima*, the fungus which produces "canker" in trees, with those of the parasitic fungus which accompanies cancer in man and other animals. In the former case the cultures produced round spores about 1 μ in diameter, agitated by a

* Trans. Bot. Soc. Edinburgh, xxi. (1898) pp. 109–13 (1 pl.).

† Ber. Deutsch. Bot. Gesell, xvii. (1899) pp. 145–51 (1 pl.).

‡ Zeitschr. f. Pflanzenkrank., viii. (1898) p. 263. See Bot. Centralbl., lxxix. (1899) p. 71.

§ Öf. kongl. Vet.-Akad. Förh., 1899, pp. 5–19. See Bot. Centralbl., lxxix. (1899) p. 130.

‖ Zeitschr. f. Pflanzenkrank., viii. (1898) pp. 283–95. See Bot. Centralbl. lxxix. (1899) Beih., p. 530.

¶ Bot. Gazette, xxvii. (1899) pp. 467–72 (4 figs.).

** Bull. Torrey Bot. Club, xxvi. (1899) pp. 373–5 (1 pl.).

†† Zeitschr. f. Pflanzenkrank., ix. (1899) pp. 1–10 (4 figs.). See Hediwiga, xxxviii. (1899) Beibl, p. 162.

‡‡ Malpighia, xi. (1899) pp. 73-86 (2 pls.).

§§ Riv. Patol. Veget., vii. (1898) pp. 162–70 (8 figs.).

‖‖ Comptes Rendus, cxxix. (1899) pp. 118-20.

brownian movement, and having a strong tendency to agglomerate, and multiplying endogenously or by budding. The spores, spherules, conids, and hyphæ present staining reactions and biological characters identical with those of the human parasite.

Inoculation of trees with cultures of the human parasite resulted in a "canker" in all respects resembling that produced by *Nectria*; and conversely, the ingestion of rabbits by cultures of *Nectria* caused the production, in about three months, of round ulcers in the stomach, similar to those produced by the ingestion of cultures of the human parasite.

Sphæronema.*—M. A. de Jaczewski gives a monograph (in French) of this genus of Ascomycetes, of which he makes 72 species (two of them new), arranged under two divisions, the pseudoparenchymatous and the prosenchymatous, rejecting a large numbnr as belonging to other genera or as insufficiently known. Six others are assigned to a new genus *Pseudographium*, with the following diagnosis:—Forming brown vertical masses composed of agglutinated hyphæ which separate at the apex in a tuft, and put out, laterally and in the interior of the bundle, conids which usually form a more or less distinct cluster.

Systematic Position of Microsporum.†— MM. L. Matruchot and C. Dassonville have already‡ demonstrated that *Trichophyton* and *Achorion* should be placed in the Ascomycetes among the Gymnoasci. They now apply the same arguments to *Microsporum*. The conidial apparatus is of the same type as those of *Gymnoascus*, *Ctenomyces*, and *Trichophyton*. The spores are solitary and grow laterally and irregularly on the filaments. They are formed by transport and encysting of the protoplasm, and are attached by a more or less broad surface. Another argument is furnished by the presence of pectinaceous hyphæ, similar to those of *Ctenomyces*. Whether *Microsporum* should be retained as a distinct genus, or sunk, with *Ctenomyces*, *Trichophyton*, and *Achorion*, in *Gymnoascus*, the authors leave an open question.

Fertilisation of Tuber.§—Prof. A. N. Berlese thus sums up his researches on the mode of impregnation and the development of the ascospores in *Tuber brumale*. The ascus, when scarcely differentiated from the supporting filament, contains two nuclei which fuse together at an early period, so that in the fully formed ascus there is only one. This nucleus then multiplies by three acts of karyokinetic division. At the same time there appears in the ascus a quantity of cytoplasm which serves for the development of the ascospores. As mitosis of the nucleus takes place within the cytoplasm, the kinoplasm becomes differentiated from the trophoplasm in the form of filaments radiating from two points which constitute the poles of the spindle. The kinoplasm determines the formation of the parietal layer of protoplasm of the ascospores, which becomes differentiated within the trophoplasm. The nucleus of the ascospore divides, giving rise to four or six daughter-nuclei.

Adaptation of Uredineæ to different Host-Plants.‖—Herr P. Dietel discusses the question whether certain Uredineæ which are now confined

* Nouv. Mém. Soc. Imp. Nat. Moscou, xv. (1898) pp. 275–386 (1 pl.).
† Comptes Rendus, cxxix. (1899) pp. 123–5. ‡ Cf. this Journal, *ante*, p. 520.
§ Riv. Patol. Veg., vii. (1899) pp. 143–52 (1 pl.).
‖ Bot. Centralbl., lxxix. (1899) pp. 81–90, 113–7.

to special host-plants, were at an earlier period capable of existing upon more than one, and answers the question in the affirmative. Instances are named belonging to several different genera in which this was probably the case. These heterœcious species became gradually limited, in the course of their development, to a single host-plant. Herr Dietel is acquainted with only one species—*Puccinia Dayi* Clint. (= *P. Dieteliana* Syd., *P. limosa* Magn.), in which, in addition to the heterœcious form and that in which æcidia are unknown, there is also an autœcious form with æcidia.

Brown Rust of Cereals.*—In an exhaustive investigation of the fungus which causes the brown rust of cereals, *Puccinia rubigo-vera*, Herr J. Eriksson proposes to split it up into six species, the first only of which is known in the æcidiospore stage :—(1) *P. dispersa* (*Æcidium Anchusæ* on *Anchusa arvensis* and *A. officinalis*), *Uredo dispersa* on *Secale cereale* and *S. montanum* ; (2) *P. triticina* sp. n. on *Triticum compactum*, *dicoccum*, *Spelta*, and *vulgare* ; (3) *P. bromina* sp. n. on many species of *Bromus* ; (4) *P. agropyrina* sp. n. on *Triticum repens* ; (5) *P. holcina* sp. n. on *Holcus lanatus* and *mollis* ; (6) *P. Triseti* sp. n. on *Trisetum flavescens*. Of these the first and second only are of great importance in agriculture, the first being very destructive to rye, and the second being apparently the only species which causes rust on wheat in Europe, the United States, and Australia.

Rabenhorst's Cryptogamic Flora of Germany (Fungi imperfecti).—The two most recently published parts of this work (Lief. 65, 66) continue the enumeration and description of the *Sphærioideæ*. The genus *Aposphæria* is completed with a total list of 60 species; then follow *Dendrophoma* (35 sp.), *Asteromella* (5 sp.), *Crocicreas* (2 sp.), *Sclerotiopsis* (1 sp.), *Plenodomus* (4 sp.), *Mycogala* (2 sp.), *Sphæronema* (61 sp.), *Glutinium* (2 sp.), *Neottiospora* (2 sp.), *Sirococcus* (4 sp.), *Chætophoma* (11 sp.), *Asteroma* (86 sp.), *Cicinnobolus* (7 sp.), *Byssocystis* (1 sp.), *Muricularia* (1 sp.), *Staurochæte* (1 sp.), *Pyrenochæta* (21 sp.), and *Vermicularia*, of which 48 sp. are described.

Protophyta.

a. Schizophyceæ.

New Genera of Schizophyceæ.†—Herr E. Lemmermann describes the plankton algæ collected in Prof. Schauinsland's voyage in the Pacific in 1896, 97. Very extensive lists from different localities are given, the Peridinieæ being included in the enumeration, and the general features are pointed out of the plankton flora of the Pacific Ocean. The following are new genera of Schizophyceæ.

Cœlosphæriopsis. Cells spherical or elongated, enclosed in a gelatinous sheath, distributed in a single layer over the surface of gelatinous hollow spheres, which are combined into botryoid colonies ; multiplication of the cells by division of the spheres in the form of budding.

Chondrocystis. Thallus expanded, a foot high, forming cushions visible to the naked eye, soft, cartilaginous, easily broken up, often calcified below, wrinkled on the surface, composed of a number of separate

* Ann. Sci. Nat. (Bot.), ix. (1899) pp. 241–88 (3 pls.). Cf. this Journal, 1895, pp. 84, 209.

† Abhandl. Nat. Ver. Bremen, xvi. (1899) pp. 311–98 (3 pls.).

parts connected together, containing groups of cells, encapsuled within one another in nests, with cell-walls more strongly thickened on one side.

Haliarachne. Filaments multicellular, arranged in two layers in a roundish or elongated free-swimming gelatinous stratum, radiating from its centre like the bent legs of a spider, and curved into a hook at the end.

Katagnymene. Filaments multicellular, free-swimming, with thin close-fitting sheaths, lying in a broad swollen gelatinous general sheath, very readily breaking up into fragments.

Pseudo-pleurococcus g. n.* — Dr. Julia W. Snow establishes this genus of lowly algæ, obtained from the bark of trees, including two species, *P. botryoides* from America, and *P. vulgaris* from Switzerland. The following is the diagnosis of the genus:—Thallus; in the atmosphere either unicellular or forming parenchymatous masses of cells of various sizes; in liquid media filamentous; cells 6·5–8 μ in diameter; chromatophore parietal, but not completely lining the membrane; nucleus single. Both species contain a pyrenoid in each cell. The existence of this genus is regarded by the authoress as accounting for the alleged polymorphism of *Pleurococcus*, for which it is easily mistaken.

New Species of Oscillatorieæ.† —M. M. Gomont enumerates and gives diagnoses of all the new species of Oscillatoriaceæ discovered since the publication of his monograph of the family in 1892.‡ A considerable number of them have been found as a coating on damp rocks. M. Gomont takes the opportunity of defending some points in his classification of the family which have been attacked.

β. Schizomycetes.

Nature of Bacteria and their Position among Fungi.§—According to Dr. W. Winkler bacteria develope from plasmodes, which consist of plasma containing granules, and often exhibit amœboid movements and small vacuoles. From the plasmodes are produced bacteria, plasmodes, thallus forms (filidia, membranes, &c.), bacterioblasts, and sporanges. Megaspores originate in the sporanges, and macrocysts in plasmodes. The basis of all bacterial colonies and zooglœæ is the plasmode. The author appears to see a connection between bacterial and protozoal plasmodes, and regards the involution forms of bacteria as regular stages in the developmental cycle Sarcina-forms are bacterioblastic fission plasmodes, and the bacteroids of Leguminosæ are bacterioblasts.

Reducing Properties of Bacteria.‖ — Dr. F. Müller employed two pigments, litmus and methylen-blue, in an investigation on the reducing properties of bacteria. Both of these possess the characters essential for such an examination; their oxidation stage is easily reduced, and their reduction-stage readily reoxidised by atmospheric oxygen; they are easily soluble in water, the medium remaining clear; they exert no poisonous

* Ann. of Bot., xiii. (1899) pp. 189–95 (1 pl.).
† Bull. Soc. Bot. France, xlvi. (1899) pp. 25–41 (1 pl.).
‡ Cf. this Journal, 1892, p. 838.
§ Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 569–79; 617–29 (2 pls.).
‖ Op. cit., 1te Abt., xxvi. (1899) pp. 51–63.

action on bacteria. The chief results obtained were that litmus offered greater resistance to bacterial reduction than methylen-blue, and that in consequence the latter was more suitable than the former for experimental purposes. One of the conclusions arrived at was that, while most bacteria possess reducing properties, a reduction might not be perceptible from their action on pigments owing to special conditions.

Many bacteria lose the power of reducing pigments at 37° which they possess at 16°. The behaviour of different bacteria to pigments may be different, i.e. while some reduce only methylen-blue, others will reduce methylen-blue and litmus, and among the latter are some which reduce litmus more energetically and persistently than methylen-blue. The explanation of this difference in bacterial behaviour is perhaps to be sought in the specifically different metabolic processes of the protoplasm rather than in the reducibility of the pigments.

The reduction process is regarded as being brought about through the agency of the metabolic products, and not by the bacterial protoplasm.

The intensity of reduction in those bacteria which easily reduce methylen-blue is proportional to the degree of the growth-energy of those bacteria; and the rapidity of reduction is regarded as an expression of the aerobic or anaerobic growth-peculiarities of the bacteria. It is pointed out that the difficult reducibility of litmus might be employed as a diagnostic criterion between *B. typhosus* and *B. coli*, as the former never reduces litmus and the latter always does.

Ocean Bacteria.*—Prof. Fischer and Dr. Bassengo have investigated at different times a section of the Atlantic stretching from 60° north latitude to 8° south. Near land the number of bacteria was greatest, and diminished rapidly seawards. On the edge of an ocean current, and especially where a current came up from below, they were more numerous again. Bacteria were more numerous below than on the surface; they were found at a depth of 1100 m. (596 fathoms), and between 200 and 400 m. existed in greater numbers than at the surface. The paucity at the surface is attributed to the germicidal action of sunlight. Most of the kinds were bacteria; hyphomycetes were few, and found only near land; blastomycetes occurred abundantly, and at such distances from land that it is certain they develope in the sea. The bacteria were of all sizes and shapes, and all were endowed with spontaneous movement in certain stages of development. None were sporogenic; some were potential anaerobes, some chromogenic, and some luminous.

Composition and Nature of Tuberculin.†—In a preliminary communication on the chemical composition of tubercle bacilli and tuberculin, Dr. Vignerat remarks that, according to Koch, tubercle bacilli consist of three substances, tuberculin and two fatty acids, one of which is soluble in alcohol and the other not. It is to the fatty acid insoluble in alcohol that the specific staining of the bacilli is due. After detailing the steps of his chemical investigations, the author remarks that tuberculin reacts with $BaCl_2$ and Fe_2Cl_6 like succinic acid salts; and when treated with nitric acid and evaporated, crystals of succinic acid are obtained by

* Deutsche Med. Wochenschr., Sept. 14, 1899. See Brit. Med. Journ., 1899, ii. p. 864. † Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 293-4.

means of alcohol. Tuberculous animals also react with succinic acid, while *per os* neither tuberculin nor succinic acid has any effect. Animals affected with *Echinococcus* react to tuberculin, and this is not to be wondered at considering that these cestodes contain succinic acid. If tubercle bacilli are heated to 180°, crystals of succinic acid are formed, and these are quickly dissolved in acidulated ether. Succinic acid, then, plays the principal part in tuberculosis and tuberculin. TO or TR is nothing else than an aqueous solution of an alkaline succinate, of little commercial value, and obtainable of any chemist. Full details are promised later.

Variations in the Liquefying Power of Milk Bacteria.* — Prof. H. W. Conn describes two series of experiments with milk bacteria, which show that conditions in nature can produce wide differences in their physiological properties. Two examples are dealt with. The first, a micrococcus, was found in all the specimens of the milk and in the air of the cowshed. Under the same conditions another coccus was found in equal abundance, the only difference between the two being that the latter did not liquefy gelatin. Their principal common feature was yellow growth on gelatin-agar and potato. Milk was curdled at 36° in three days with an amphoteric reaction.

The curd was subsequently little or not at all digested. Further researches established the fact that there are numerous gradations between the two cocci, and that apparently they are natural varieties of one species. Later on analogous variations were noticed as to the colour; many of the colonies were white or whitish-yellow, and these were also found under natural conditions. The second bacterium was a bacillus which produced yellow and white colonies. This possessed general characters resembling those of *Bacillus lactis erythrogenes*, except the red colour, but when inoculated on agar the medium assumed a rose-pink tinge. Just as in the case of the coccus, the two varieties of the bacillus remained true, the one liquefying and the other refusing to do so. The conclusion seems therefore clear that they must be varieties of the same organism, and if so, then there are numerous problems in natural environment yet unsolved.

Chemical and Bacteriological Examination of Water and Sewage.† —The committee appointed by the British Association to establish a uniform system of recording the results of the chemical and bacteriological examination of water and sewage, suggest in an interim report that in the case of all nitrogen compounds the results be expressed as parts of nitrogen per 100,000, including the ammonia expelled in boiling with alkaline permanganate, which should be termed albuminoid nitrogen. The nitrogen will therefore be returned as (1) ammoniacal nitrogen from free and saline ammonia; (2) nitrous nitrogen from nitrites; (3) nitric nitrogen from nitrates; (4) organic nitrogen (either by Kjeldal or by combustion); (5) albuminoid nitrogen. The total nitrogen will be the sum of the first four determinations. The purification effected by a process will be measured by the amount of oxidised nitrogen as compared with the total amount of nitrogen existing in the crude sewage.

* Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 665–9.
† Journ. Soc. Arts, xlvii. (1899) p. 835.

The committee are unable to suggest a method of reporting bacterial results, including incubator tests, which is likely to be acceptable to all workers. They also make some practical suggestions relative to taking samples of sewage for analysis.

Bacterial Purification of Sewage.*—In his Cantor Lectures Dr. S. Rideal took as his theme the purification of sewage by bacteria. The earlier portions are historical, and descriptive of the primitive methods of disposal of sewage. The different methods and systems of treating and getting rid of domestic and manufacturing sewage which were in vogue before the biological treatment was adopted, are alluded to and described in turn. The greater part of the discourses is reserved for bacteria and their work, and it is shown that any system for the disposal of sewage, to be effective, must be based on the alternate action of anaerobic and aerobic bacteria. For in this way almost all the sludge is caused to disappear as gas, and the filtrate rendered comparatively innocuous. The lectures contain a large number of facts bearing directly and indirectly on the subject of sewage and sewerage.

Fermentation of Malic Acid by Bacteria.†—Herr O. Emmerling isolated from a solution of malic acid, in which fermentation had been induced by inoculation with one drop of putrefying flesh, *Bacillus lactis aerogenes.* This bacillus, first discovered by Escherich in the intestines of sucklings, is a short thick non-motile bacillus, and was identified by the form of its colonies, the milky white appearance of the gelatin culture, the absence of spores, and by decolorising by Gram's method. In a solution of bouillon and sugar it developes hydrogen and carbonic anhydride in molecular proportion. The pure culture acts on malic acid, reducing it to succinic acid, almost quantitatively according to the equation $3C_4H_6O_5 = 2C_4H_6O_4 + C_2H_4O_2 + 2CO_2 + H_2O$. Alcohol is not produced, but traces of formic acid can be detected. The conversion of malic acid into succinic acid by brewer's yeast is due to bacteria, and does not take place with pure cultures. König has shown that tartaric acid is largely reduced to succinic acid by *B. termo*, but *B. lactis aerogenes* appears to cause decomposition in other directions.

Movement of Bacilli in Liquid Suspension on Passage of a Constant Current.‡—Dr. A. F. Bill passed a constant current through suspensions of various micro-organisms. On closure of the current a movement set in towards the positive pole, while at a lower level there was a reverse stream towards the negative pole. Two exceptions were found:—(1) in 1 per cent. pepton where the current was delayed or never set in; (2) in bouillon the course of the currents was reversed.

Experiments with unorganised and finely powdered substances produced the same results, and the observations suggest that the movements towards one or other pole are of a physical nature; that they are not physiological or galvanotropic.

Three new Lactic Acid Bacteria.§—Herr E. Weiss describes three new bacteria which were isolated from the juice of turnips. The

* Journ. Soc. Arts, xlvii. (1899) pp. 683–9, 695–703, 707–17, 719–30 (6 figs.).

† Ber. Deutsch. Chem. Gesell., xxxii. (1899) pp. 1915–8. See Journ. Chem. Soc lxxv. and lxxvi. (1899) Abst., ii. pp. 569–70.

‡ Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 257–9.

§ Journ. f. Landwirthschaft, xlvii. (1899) p. 141. See Centralbl. Bakt. u. Par. 2te Abt., v. (1899) pp. 599–601.

turnips, which were those used for fodder, had undergone the lactic fermentation.

Bacterium acidi pabuli i. Motionless cylindrical rodlets with angular ends, 1·2 μ long and 0·7 μ broad. The size was, however, greatly dependent on the medium, the cultivation, and the growth. The microbe was easily stained. Spore-formation was not observed. It is a potential anaerobe. It acidifies milk, which at 30° coagulates on the third day. The whole fluid sets to a homogeneous mass without separation of serum. The optimum temperature is between 10° and 20°. At 70° it is quickly killed.

Bacterium acidi pabuli ii. This organism regularly coagulates milk at 30° in five days. It is a motionless rodlet, 1–1·2 μ long and 0·5 μ broad. In milk, however, it may be as long as 2–3 or 4 μ. Spore-formation was not observed. In saccharated media it grows well and forms acid. It does not produce gas. Though an aerobe, too much air inhibits its activity. Its optimum temperature lies between 30° and 40°.

Bacterium acidi pabuli iii. This bacterium is distinguished from the foregoing by coagulating milk after nine days and producing gas. It is motionless, 1·5–2·5 μ long and 0·8–1·1 μ broad. When dividing fast the segments may be coccoid. It retains its shape in all media. It does not develope resting forms. Growth and activity were unaffected by complete exclusion of air, while too copious access was decidedly detrimental. Its optimum temperature is 30°. It is destroyed in one hour at 60°, and in fifteen minutes at 70°.

All three organisms excite spontaneous lactic acid fermentation, and the presence of sugar is indispensable to their vital requirements. Cane-sugar was fermented very well by i. and ii. and badly by iii., but if it were inverted, then bacterium iii. made use of it. The proportion of lactic acid to other acids present in the turnips is given as 1 to 9. The acidification takes place soon after stacking, when volatile and non-volatile acids are formed. As fermentation proceeds the quantity of non-volatile acid (lactic) diminishes, and the volatile increase, apparently being formed from the salts of the former. Among the latter, acetic acid predominates; and this is all the more striking as so little air is present in the stacks, while the acetic fermentation demands free access of air.

Presence of Tubercle Bacilli in Margarin.*—Dr. Morgenroth states that true virulent tubercle bacilli exist, and not infrequently, in margarin.

Sorbose Bacterium.†—The researches of Dr. O. Emmerling on the sorbose bacterium have enriched our knowledge of its biology, and of the existence of chitin in the vegetable kingdom. The bacterium described by Bertrand changes the sorbite in the fruit of *Sorbus Aucuparia* into sorbose. The author is able to confirm the suspicion previously hinted at by Bertrand, that the sorbose bacterium is identical, morphologically and physiologically, with *Bacterium xylinum* described by Brown. The thick membrane, consisting of zoogloea masses, which was developed by

* Hygien. Rundsch., 1899, p. 481. See Zeitschr. f. angew. Mikr., v. (1899) p. 180.
† Ber. Deutsch. Chem. Gesell., 1899, p. 541. See Centralbl. Bakt. u. Par., 2te Abt., v. (1899) p. 657.

B. xylinum on suitable media, was considered by Brown to be cellulose. According to the author this is incorrect. The zooglœa membrane contains only 2–3 per cent. nitrogen, and is insoluble in ammoniated copper oxide. It dissolves in strong hydrochloric acid when heated in a water-bath for two hours. When the mass, evaporated down to a syrupy consistence, has been treated with alcohol, the residue dissolved in water and decolorised with animal charcoal, glucosamin crystals are produced after evaporation and juxtaposition with sulphuric acid. This formation of glucosamin shows that the cell-membrane of the sorbose bacterium does not consist of pure cellulose, but contains a chitinoid body. Winterstein and others have demonstrated the presence of chitin in vegetable membrane, and Ruppel the probability of its existence in tubercle bacilli. In *B. xylinum* must be recognised another vegetable organism which contains chitin.

Ætiology of Yellow Fever.* — The United States Commission, appointed to investigate the cause of yellow fever, have issued their report. The chief conclusions therein are that *Bacillus icteroides* Sanarelli is the cause of yellow fever, and that the *Bacillus x* of Sternberg † has no causal relationship to the disease. They have discovered evidence that *B. icteroides* developes, both *in vitro* and *in vivo*, an extremely potent toxin, from which it is anticipated a very powerful anti-serum may eventually be obtained.

Bacteriology of Fowl Epidemic in North Italy. ‡ — Dr. C. Mazza reports that an epizootic has been raging among fowls in certain places in North Italy. The symptoms were quite like those of fowl cholera. From the juice of various organs a microbe was cultivated which grew well on the usual media, e.g. bouillon, blood-serum, agar, gelatin, and potato. In glucose bouillon gas was produced, and the reaction became acid; no indol was formed. Milk was not coagulated. Stained preparations of 24 hours old cultures showed coccoid rodlets, frequently in pairs ($0 \cdot 7\ \mu$ long by $0 \cdot 6\ \mu$ broad). In older cultures the rodlets were a little longer, and were sometimes swollen in the middle.

Fowls and pigeons were found to be extremely sensitive to inoculation either by feeding or by subcutaneous injection. The morbid appearances were of course different; in the one case resembling gastro-enteritis, in the other hæmorrhagic septicæmia.

From the fowl cholera bacillus the new microbe is distinguished by its shape and size and motility; by not coagulating milk; and in being but little pathogenic to rabbits.

Hyphomicrobium vulgare.§—Under this name Herren A. Stutzer and R. Hartleb describe a fungus which has a very extensive distribution in the soil. It is a constant companion of nitrifying organisms, and is with difficulty removed from the cultures. *Hyphomicrobium vulgare* is unable to form either nitrite or nitrate, though these substances in nutrient media serve the fungus as source of nitrogen. It is not cultivable on ordinary substrata, and the special media employed for nitri-

* Lancet, 1899, ii. p. 902. † Cf. this Journal, 1898, p. 121.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 181–5.
§ Mitteil. landwirthschaftl. Inst. k. Univ. Breslau, 1898. See Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 678–82.

fying organisms must be employed for its isolation. On plates the deep colonies are brownish; the superficial are highly refracting droplets. On nitrite-agar the growth consists of a deposit of colourless droplets. The microbe is best stained with carbol-fuchsin, and is then seen as a small homogeneous rodlet with pointed ends. It is endowed with a sheath or capsule, and measures 0·6–0·8 by 1–1·5 μ. There are other morphological forms, the most prominent being the filament, which may exhibit true branching. As already stated, the microbe will not develope in ordinary substrata, and it appears to be extremely sensitive to ingredients commonly used in nutrient media. It does not pick up free nitrogen, but can make use of atmospheric carbonic acid. Another characteristic is that it is extremely sensitive to free acids, in which it differs from most Hyphomycetes. Hence it differs morphologically from Schizomycetes and physiologically from Hyphomycetes. For the composition of the numerous cultivation media the original should be consulted.

Morphology of Bacillus Mallei.*—Prof. B. Galli-Valerio made observations which confirm the fact that in cultures of *Bacillus Mallei* there may be found filamentous forms 16–80 μ long, real and false branched forms, and forms often ending in club-shaped extremities. These forms, which are especially frequent in pepton-bouillon cultures, bring *B. Mallei* into proximity with *Streptothrix*, forming together a group between Hyphomycetes and Schizomycetes.

On other media, such as potato, carrot, gelatin-serum, agar, the elements were less filamentous and shorter.

The filamentous forms were not observed in the lesions of inoculated guinea-pigs, and in the peritoneum of the frog all the forms were extremely small.

Micrococcus tetragenus.†—MM. Bosc and L. Galavielle obtained their material from gangrenous pneumonia in a man. They found that the organism was easily cultivable on the ordinary media. It requires oxygen, and its optimum temperature is 37°–38°. In alkaline media it developes luxuriantly, but scantily in acid. It is polymorphic, and forms varying from a single coccus to zooglœa heaps are met with. It is pathogenic to guinea-pigs, mice, and rabbits, and to some extent to pigeons. It has no effect on fishes or frogs. Subcutaneous injections caused abscesses. Filtered cultures produced toxic phenomena, the intensity of which varied with the quantity injected and with the animal. Immunisation experiments were mostly negative.

Bacillus pseudo-tuberculosis.‡—Dr. E. Klein states that he has produced a pseudo-tuberculosis in guinea-pigs and rabbits by injecting them with sewage-infected river water. From the necrotic foci in the lymphatic glands, liver, spleen, and lungs, pure cultures were obtained. To the morphological and biological characters given by A. Pfeiffer (1889) and by Preisz (1894) the author adds that the pseudo-tubercle bacillus is an alkali-former; it does not produce indol; on blood-serum it grows

* Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 177–80 (5 figs.).
† Arch. Méd. Expér. et d'Anat. Pathol., xi. (1899) p. 70. See Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 270–5.
‡ Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 260–1.

well and quickly, and does not liquefy the medium. In sections of lung, &c., the bacillary chains were often in knots or clumps. Though no movements were observed in hanging drops, one or even two short spiral polar flagella were demonstrable by van Ermengem's method.

The bacilli are stainable by Gram's method if the preparations are treated with the gentian solution for one minute and with iodo-potassic iodide for four. The presence of the bacilli within leucocytes was a marked and noticeable feature. Two monkeys inoculated with pure cultures succumbed on the 10th and 14th days. Deposits were found in the lymphatic glands and in the spleen. Cover-glass preparation sections of affected organs and cultures showed the presence of the bacillus in copious quantity.

Pseudo-tuberculosis of Sheep.*—An affection of sheep, associated with certain tracts of country, has been discovered in Australia. The contagion is derived from the soil, and invades the animal through injuries of the skin. It is characterised by swellings of the lymphatic glands which contain a firm friable green-coloured substance. The microbe is a short oval non-motile bacillus varying from 1/16000 to 1/8000 in. in length. On agar the colour is white, and yellow on blood-serum. It is pathogenic to guinea-pigs and rabbits, but not to dogs.

Bacillus closely resembling Pfeiffer's Bacillus.† — Dr. Elmassian, while making some investigations relative to the ætiology of whooping-cough, met with a small slender bacillus which very closely resembles the bacillus of influenza. The distinctive difference was that the new bacillus was cultivable on serum devoid of hæmoglobin, which is indispensable to the growth of Pfeiffer's bacillus. The new bacillus is not confined to whooping cough, for it was also found in other morbid conditions of the respiratory passages. It is a small bacterium about the size of the bacillus of acute contagious conjunctivitis, but a little thicker; it often presents a slight median constriction; its ends are round or pointed; and while many elements are clearly bacillary, others are coccoid. From the pneumococcus it is easily distinguished by not staining by Gram's method. It was cultivated on serum-gelose (2 per cent. pepton, 6 ccm. gelose, 3 ccm. serum), but would not grow on media not containing serum. Cultures injected into the peritoneal sac of guinea-pigs were fatal from peritonitis, pleuritis, and pericarditis. Pigeons, mice, and rabbits were refractory.

Bacillus fusiformis.‡ —Prof. H. Vincent describes a fusiform bacillus which he has found in the membrane formed in some kinds of sore throat. After staining smear preparations with thionin or fuchsin, the bacillus is observed as a rodlet 6–12 μ in length. As its designation implies, the bacillus is thicker in the middle than at the ends, which taper off to long delicate points. Involution forms are very common. It does not stain by Gram's method. All attempts at cultivation failed. This bacillus is frequently associated with a spirillum.

The existence of another and previously undescribed microbe in pseudo-membranes is interesting and important. The differences between *B. fusiformis* and *B. diphtheriæ* are sufficiently obvious.

* Brit. Med. Journ., 1899, ii. p. 811.
† Ann. Inst. Pasteur, xiii. (1899) pp. 621–9. ‡ Tom. cit., pp. 609–19 (2 figs.).

Observations on Bacillus Ellenbachensis.* — Dr. R. Kolkwitz cultivated *Bacillus Ellenbachensis* on media in which earthworms were an important ingredient. The chief observations relate to the spores, which measured about 1·7 μ by about 1 μ. Some of the measurements were made in monobromnaphthalin. Germination invariably takes place in the long axis, and not laterally as in *B. megaterium* de Bary, a point of importance considering the general resemblance of the two. The spore membrane remained sticking to one pole of the rodlet. Not unfrequently two membranes were observed, the outer being found to be the remnants of the maternal cell-membrane. Occasionally, both ends of the young rodlet were covered, the one by the spore membrane, the other by cell-remnant.

When grown on potato saturated with 2 per cent. grape sugar solution, larger granules resembling spores appear. They, however, do not germinate, and stain brown with iodine very quickly.

The earthworm media used were agar and bouillon. The former was prepared by killing 40 ccm. of earthworms by means of hot water, crushing up the bodies in a mortar, and mixing with 300 ccm. of tap water. Two per cent. of agar was added, and the medium allowed to set without being filtered.

* Centralbl. Bakt. u. Par., 2te Abt., v. (1899) pp. 670–8 (1 pl.).

MICROSCOPY.

[The Publication Committee of the Journal has decided on resuming the issue of the Microscopic Bibliography, which was dropped on the lamented death of Mr. John Mayall, jun. It is intended in future to give at least the title of every work or paper (commencing from January 1st, 1899) coming under the head of Microscopy A or of Technique 3 (Microtomes); and we shall be much obliged to any of our Fellows who will call our attention to any such papers or articles published in Journals which are likely to escape our notice.—EDITOR.]

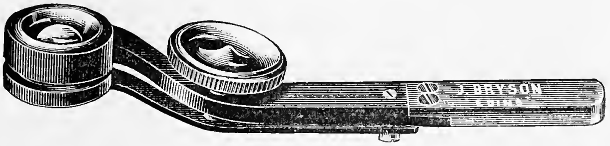
A. Instruments, Accessories, &c.*

(1) Stands.

Three Small Hand-Microscopes.—A case containing three Microscopes was exhibited at the meeting of the Society on Nov. 15th, by Mr. Edward Swan, one of which is represented in fig. 149. The following account of them was given by the President.

"They are interesting from several points of view. First, it will be noticed that although they are of archaic type, they are of comparatively modern manufacture. This kind of Microscope was first designed by Leeuwenhoek about 1673, but his screw focussing arrangement was of a very crude construction. In 1702 we find a considerable improvement

FIG. 149.



effected by Musschenbroek and Wilson. The highest pitch to which these instruments arrived can be well seen in the extract from Ledermüller's work.† This last instrument was called a 'Compass' Microscope, because the lens was mounted on one leg of a 'spring divider' compass, the object being placed on the other leg, and focussing adjustment being performed by means of the screw which worked the spring divider; this, in short, was the principle underlying all the above-mentioned instruments, as well as those now on the table.

"As some of Lieberkühn's improvements are incorporated in the 'Compass' Microscope, its date could not be earlier than 1745, nor later than the publication of Ledermüller's book in 1763. Now, to return to the three Microscopes on the table, as they are fitted with Coddington lenses, they cannot have been made earlier than 1830, but from the appearance of their workmanship they may be dated as late as 1860.

"The history of the Coddington lens is also of interest; for Cod-

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

† Cf. this Journal, *ante*, p. 529.

dington neither claimed nor had anything to do with its introduction; it was Dr. Goring who attached Coddington's name to it.* Wollaston suggested the use of two plano-convex lenses, placed with their plane sides in apposition, with a diaphragm between them. Brewster subsequently pointed out that a great improvement would be effected by making each lens a hemisphere; for then the incident and emergent pencils would meet the surfaces normally. Brewster's next step was to simplify its construction by substituting a grooved sphere for the two hemispherical lenses. The sphere has been quite given up, and for long the construction has been that of a grooved cylinder.

"There is yet a further point of interest connected with the achromatism of this form of lens. All are aware that an achromatic effect is obtained in an eye-piece by regulating the distance between the two converging lenses, made of the same kind of glass, so that the coloured images of varying size, formed by the excentrical pencils which fall on the first lens, may be unequally magnified by the second lens, in such a manner as finally to make uniformly magnified images. These final images, being superimposed, and all of one size, form a single image that is achromatic for the purposes intended. Now a similar effect can be secured in a single lens by separating its refracting surfaces from each other; in other words, by making the lens of a certain thickness. The partial achromatism which is obtained in the Coddington lens is therefore due to its thickness.

"Notwithstanding the theoretical advantages just enumerated, viz. first, the normal incidence of the rays, and secondly, the achromatic compensation by thickness, it cannot be said that the Coddington is altogether a successful form of lens. Its defects, three in number, are, smallness of working distance, curvature of image, and want of light. There can be no doubt that its performance is incomparably inferior to that of the Wollaston doublet. For example, a Wollaston doublet in my possession shows tubercle bacilli with considerable clearness.

"Returning now, after this long digression, we must admire the admirable workmanship of these three little Microscopes. They appear to be a part of a doctor's outfit, and may have been used for the examination of blood. The highest power is the smallest Coddington lens I have yet seen."

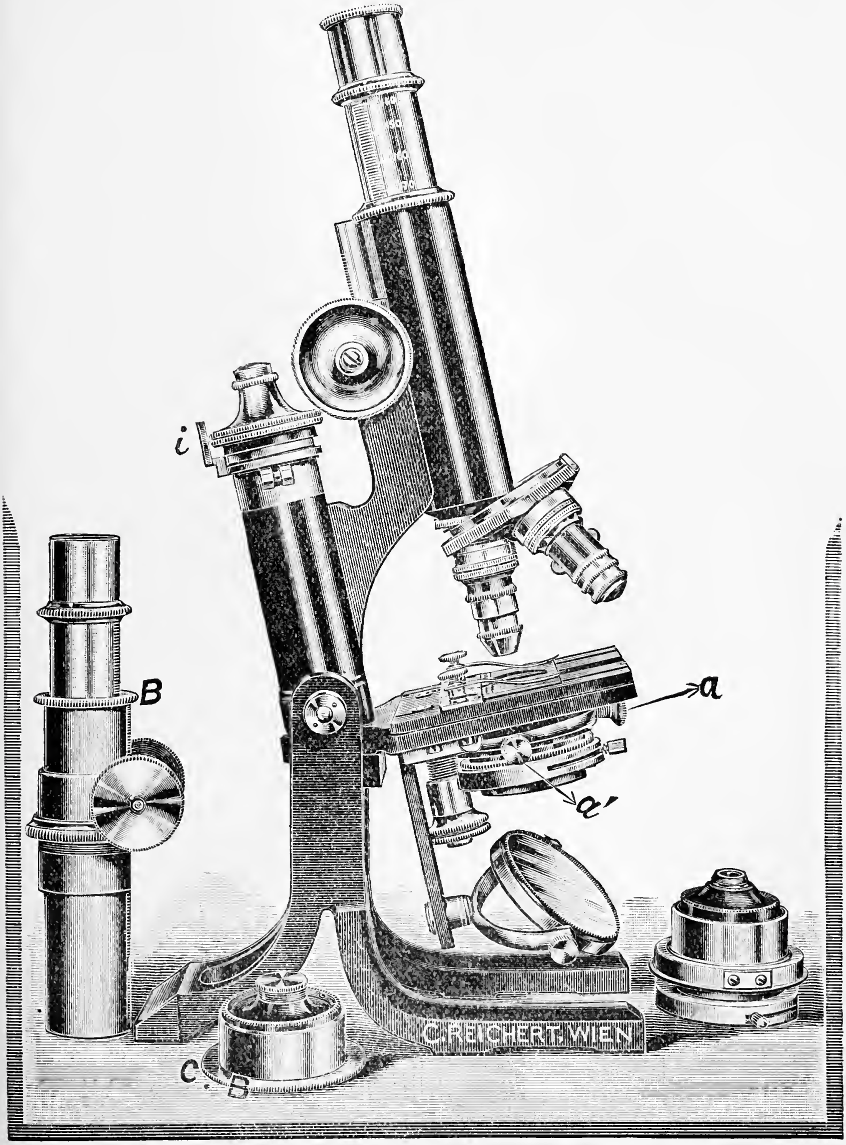
Reichert's New Microscope.—Fig. 150 is an illustration of Reichert's "Baugh" Microscope, which was exhibited by Mr. C. Baker at the October meeting. It is fitted with the new lever fine adjustment which was figured and described on page 374 *ante*. It should be noted that the index, *i*, for reading the divisions on the head of the micrometer screw, is capable of being rotated, so that it can be placed to the zero point wherever that may happen to be.

The foot is lighter, and yet more stable, than those of the usual pattern. The stage is of Nelson's horseshoe form, and the substage is of the ordinary Continental side-screw focussing pattern; but it is also fitted with centering screws, *a a′*. The rackwork draw-tube, B, which can be screwed into the body, in place of that of the ordinary form, is a feature quite novel to modern Continental Microscopes, though it was

* See Micrographia, p. 182.

employed for a short time by Oberhäuser, *circa* 1840*; but rackwork was first applied to the draw-tube by Benj. Martin, *circa* 1780. The rack-

Fig. 150.

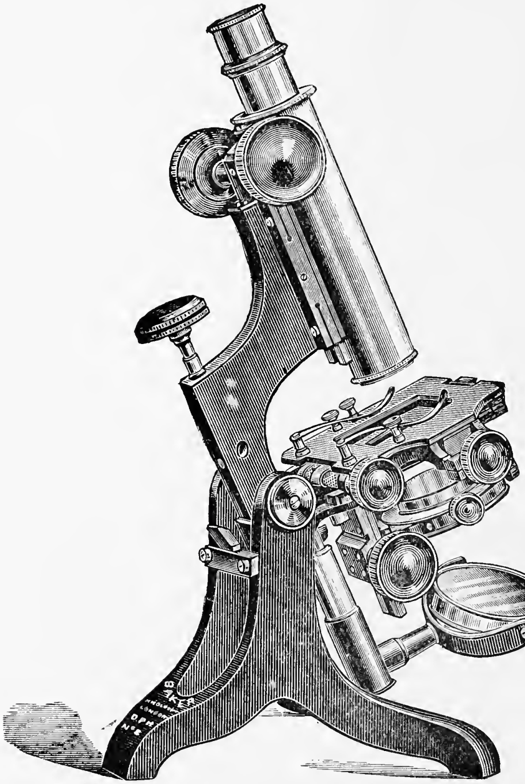


* See Quekett on the Microscope, 1st ed., 1848, p. 326.

work draw-tube in those early days was intended solely for the purpose of obtaining large variations in power apart from changing the objective; now, however, it is only used for the purpose of correcting the objective, i.e. as a substitute for collar correction.

Baker's D.P.H. Microscope No. 1.—This instrument (fig. 151) has diagonal rack-and-pinion coarse movement, micrometer screw, and lever fine adjustment, giving a movement of 1/225 of an inch for each revolution of the milled head; draw-tube, every 10 mm. of which is engraved

Fig. 151.



with a ring, extending from 150 mm. to 250 mm., thus allowing the use of either English or Continental objectives; mechanical stage giving a movement of 25 mm. in either direction, graduated to 1/2 mm., the milled heads being below the level of the top plate, so that large culture plates can be used; the distance from optic axis to limb ($2\frac{1}{2}$ in.) allowing of their easy manipulation. The stage has stops to enable either a 3 in. by 1 in. or a 3 in. by $1\frac{1}{2}$ in. slip to be brought always to the same place for the purpose of recording any given field; but these, together with the stage clips, are removable.

It has a centering substage of universal size ($1\frac{1}{2}$ in.) with diagonal rack-and-pinion focussing adjustment; plane and concave mirrors on the movable arm.

The whole is mounted on a solid tripod foot as figured.

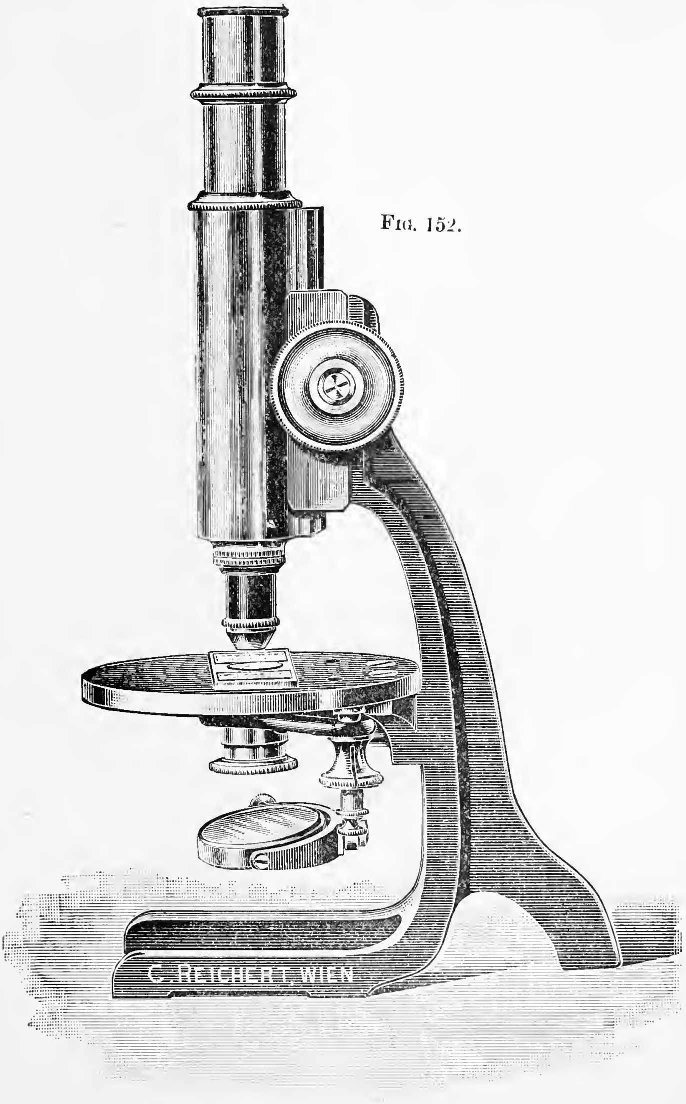


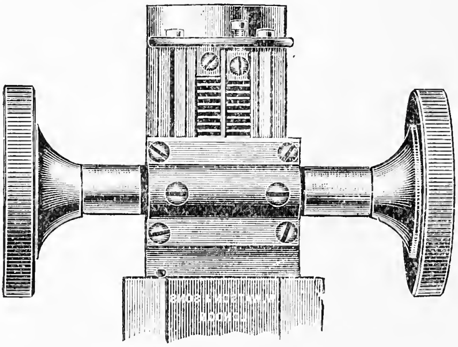
FIG. 152.

Reichert's Cheap Non-inclinable Stand.—Fig. 152 represents Reichert's cheap non-inclinable stand, fitted with a spiral rack-and-pinion coarse adjustment, but without a fine adjustment. The substage, which consists merely of an arm capable of being thrown to one side, is of the push focussing type; it carries an achromatic dissecting loup, which makes, as Mr. Nelson has pointed out,* an admirable condenser.

A Microscope of this kind is a very serviceable instrument for serious work, as a 1/4-in. objective can be easily worked without a fine adjustment. It is a capital plan, when using a high power on a first-class stand, to have one of these elementary Microscopes on the table as well, for it will be found in practice more convenient to move the specimen from the larger instrument to the smaller one, when it is required to observe the object under a lower power, than to employ a rotating nose-piece, for the reason that a change in power necessitates also a change in the illumination, and in altering the illumination much time will be lost.

Nelson's Stepped Rackwork (Coarse Adjustment).—Fig. 153 shows Mr. Nelson's new stepped rackwork and pinion as fitted to his Micro-

Fig. 153.



scope by Messrs. Watson and Sons.† The little screw above the right-hand rack is for the purpose of regulating the amount of "step," while the two screws in the centre of the pinion regulate the pressure by which the pinion is forced into the rack.

In ordinary rack-and-pinion work, if there is to be no "loss of time," considerable pressure is needed; but with this kind of stepped rackwork only slight pressure is necessary, "loss of time" being impossible if the right-hand rack has been properly adjusted by means of the upper screw, and then fixed by its clamping screws.

Method of Enlarging and Deepening the Field of a Compound Microscope.‡—Mr. R. Forgan exhibited a practical method of enlarging and deepening the field of a compound Microscope. The essence of the

* Journ. Quekett Micr. Club, iv. (1889) p. 77. † Cf. this Journal, *ante*, p. 261.
‡ Proc. Roy. Soc. Edinburgh, May 16th, 1899.

method consists in shortening the distance between the object-glass and eye-piece, thereby obtaining a diminution of magnification with a corresponding increase of field; the Microscope being made to act somewhat after the fashion of a telescope. A very great depth of focus is thus obtained. It is possible that this form of Microscope might be very serviceable in the study of circulating systems when high magnification is not desired.

It should, however, be pointed out that the great shortening of the tube-length will put the objective out of correction; but this would not make any important difference with the very low powers which only would be used in this manner.

Berger's New Microscope.—In the account of Messrs. Zeiss' new Microscope (Berger's model) * a description of the mechanical stage was unfortunately omitted. On referring to fig. 98, p. 584, it will be seen that the heads of the pinions are on Turrell's plan, but the outer head gives transverse movement to the stage-plate instead of vertical movement. The pitch of the screw on this pinion is fine, so that the motion is slow. The vertical movement, which is actuated by the inner pinion head, is on altogether a novel plan. The motion is one in arc; this stage-plate being pivoted on the left-hand side, has rack teeth cut in it, into which a pinion is geared. This pinion has a toothed wheel fixed to it, in which engages an endless screw attached to the pinion that carries the inner pinion head. The speed of the object at the centre of the stage is about half that of the rack, because the object is placed about half-way between the rack on the right and the pivot on the left-hand side of the stage.

The stage is concentric with simple non-mechanical rotation; it can be clamped in any desired position by a small screw at the side of the stage (not shown in the figure).

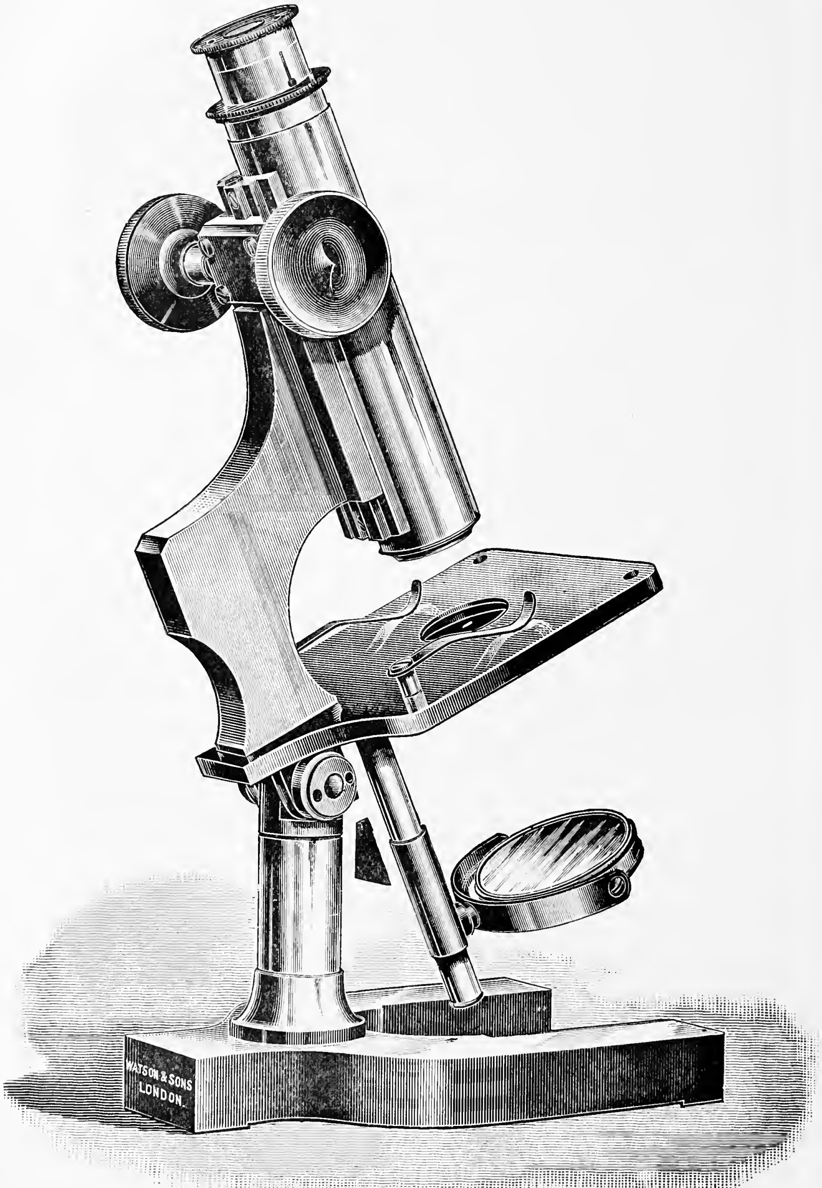
Watson and Sons' "School" Microscope.—This Microscope (fig. 154) is of plain but substantial construction, and has been designed specially for the use of schools, and for the teaching of animal and vegetable histology. The makers have adopted a suggestion that has been made on many occasions, viz. that a Microscope possessing a thoroughly good coarse adjustment without any fine adjustment should be supplied in place of the ordinary cheap student's Microscope, which is provided with an indifferent fine adjustment and plain sliding body.

The power needed for ordinary student's work can be quite well and precisely focussed by means of this rackwork and pinion. The Microscope takes the Continental size of eye-piece, and has a draw-tube. The universal fitting for substage apparatus screws into the under side of the stage; an inclining joint and adjustable double mirror are also fitted. The total height of the instrument is 10 in.

BAUSCH, E.—**Manipulation of the Microscope. A Manual for the work-table, and a Text-book for the Beginners in the use of the Microscope.**
Rochester, N.Y., 1899, 8vo, 200 pp.

* See this Journal, 1898, p. 583.

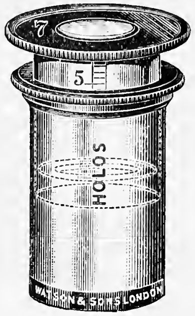
Fig. 154.



(2) Eye-pieces and Objectives.

Watson and Sons' "Holoscopic" Eye-pieces.—These eye-pieces (fig. 155) are on the Huyghenian principle; the eye-lens is attached to a draw-tube, to the lower end of which the diaphragm is fixed. When the tube is pushed in as far as it will go, the eye-piece is under-corrected; but, as it is extended, it becomes increasingly over-corrected. The latter condition enables it to be used with apochromatic objectives, and the former with the ordinary achromatic lenses. They have been specially designed to obviate the necessity for two sets of eye-pieces if a worker has both apochromats and achromats in his outfit.

Fig. 155.



Spitta, E. J.—"**Achromatics *versus* Apochromatics.**" *Amer. Mon. Micr. Journ.*, Oct. 1899, pp. 296–309.
The author gives a clear popular article on the subject.

(3) Illuminating and other Apparatus.

Notes on Optical Projection.*—After some introductory remarks upon the unfamiliarity with the principles of lantern projection frequently displayed by lecturers, Prof. Behrens describes two contrivances he has invented for the improvement of his projection apparatus.†

I. *Electric Hand Regulator for Microscopic Projection.*—He has made inquiries at various Institutes using his apparatus, and has found, with regard to the relative merits of lime-light and electric light, that the former, if used with his burner, is perfectly sufficient even for very large audiences when glass pictures are projected; and that it is even preferred to the violet arc light on account of its warm pleasant tone. But in the case of the projection of microscopic slides, a light stronger than the ordinary lime-light was desirable. On testing the following light sources with Weber's photometer, it was found that their brightness measured in meter candles was,—Schmidt and Haensch's zirconium burner, 12; Behrens' lime-light burner, 26; Schuckert's differential lamp with 20-ampère current, 125.

The superiority of Schuckert when high illumination is required is manifest, and the author has therefore adapted his apparatus for its reception, and in so doing has made use of the lamp alone without its heavy brass and iron fittings. He has moreover mounted the lamp in a light aluminium camera. In his hand regulator he has endeavoured to remedy the usual defects of arc lights, viz. their uncertainty, costliness, want of adaptability to other than their assigned current intensity, and want of interchangeability with a lime-light burner.

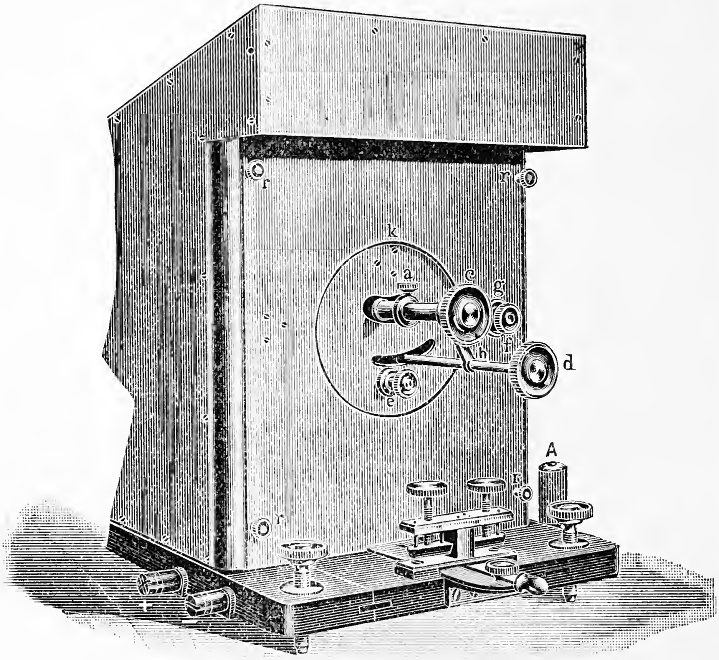
He has every reason to believe that his hand regulator thoroughly satisfies the following eight conditions:—(1) It is exchangeable for a lime-light burner; (2) it is applicable both for a constant and a variable current; (3) it is applicable for currents of the most varying intensities; (4) the current flows only through the carbon and not through the

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 183–95 (3 figs.).
† Cf. this Journal, *ante*, p. 89.

regulator; (5) the arc-light can be centered both horizontally and vertically; (6) the size of the arc is regulated by one handle only; (7) the whole regulator can be pushed about 14 cm. horizontally; (8) the entire apparatus is outside the camera.

The regulator is mounted on an aluminium plate, which forms the back wall of the camera: it is fastened thereto by the milled heads *rrrr* (fig. 156) after the removal of another similarly fastened back wall carrying the lime-light. Each back wall has a circular sinking *k*, near which is the screw *f* for centering the arc vertically; the clamp *g* fixes the regulator when centered; the screw *e* controls the horizontal centering of the arc. On loosening *a*, the whole regulator, including *c*, *h*, *d*, is moved backwards or forwards by gripping *c*. This last movement therefore serves to bring the image of the arc into the rear principal plane of the objective. Rotation of the screw *d* regulates the size of the arc light from time to time. Fig. 157, showing the inner side of the back plate, will give a clear idea of the action of the various parts. The horizontal and vertical adjustments by rotation of *e* and *f* are really circular movements about centres *n* and *m*. For controlling the size of the light the rotation of *d* is transmitted through the conically toothed wheels *o*, *p*, to two sliders *q* and *s*, which mutually approach or recede. The carbons are inclined at 45° to the vertical, so as to get the best

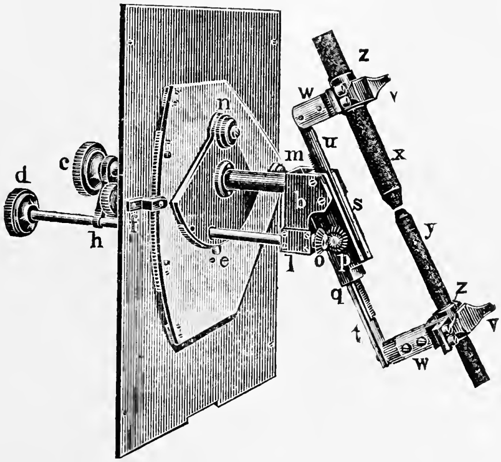
Fig. 156.



effect. The brass carbon-holders *z z*, with their clamps *v v*, are insulated by porcelain brackets *w w*. The current enters and leaves by binding screws, not visible in the figure, at the side of *z z*. Carbons of various diameters corresponding to the various current intensities can be used. Current intensity should lie between 5 and 20 ampères, the highest value being suitable for the greatest possible requirements. If an installation current is too powerful, a resistance apparatus should be introduced into the circuit. The author recommends that of Schuckert & Co.

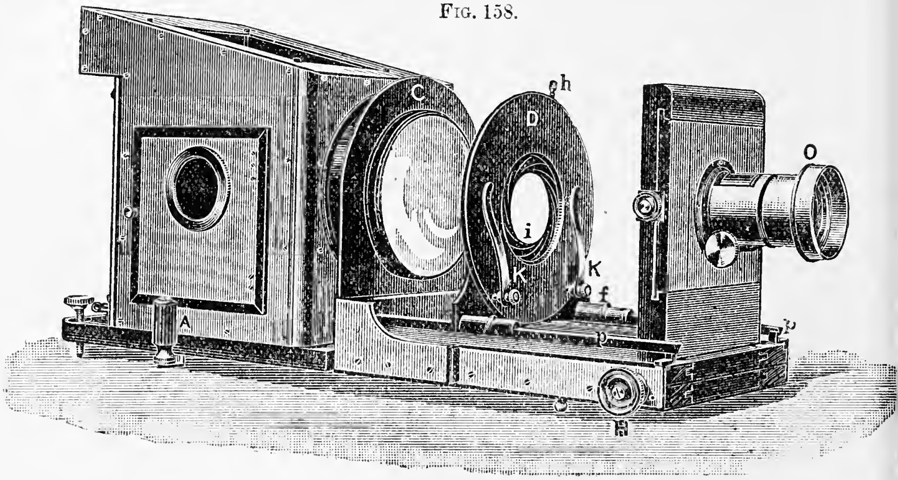
II. *The Projection of Search-Slides.*—It is frequently desirable to search systematically a section of a large organ. Such a section may be 8 or 10 cm. in diameter. Professor Behrens projects it by an ordinary photographic objective, and obtains a magnification of 25 diameters; thus the image may be some 2 metres in diameter; an iris diaphragm stops off any parts not wanted.

Fig. 157.



The arrangement is seen in fig. 158. The prismatic guides *p p*, with the diapositive bearer and the objective board O, can be removed *en masse*. D is a thick, circular, blackened, perpendicular brass plate of 22 ccm. diameter, perforated for a 10 cm. iris diaphragm operated by a lever *h*. The metal clips K K are secured by screws, which not only prevent falling out, but permit adaptation to slides of different thicknesses. If a slide is smaller than the opening, a piece of plate glass must be placed as a backing. The opening is protected on the reverse side by a plate of mica to prevent injury to the slides from overheating, and Professor Hermann (to whose suggestion the entire apparatus is due) found this mica plate so satisfactory that an exposure of 10 minutes to a 20-ampère current through a Schuckert lamp produced no melting of the Canada balsam. The diaphragm should be placed at such a distance from the condenser that the converging light-cone is but slightly larger than the iris. If a higher than 25 diameters magnification of any part be desired, that part can be projected by an ordinary microprojection objective. The diaphragm plate C D is secured to the prismatic guides by a pair of double telescoping tubes, of which the inner one is steady, and the outer,

Fig. 158.



by means of an Archimedean screw arrangement, slides on the inner; this also answers for the fine adjustment, the coarse being worked by the milled head H.

(4) Photomicrography.

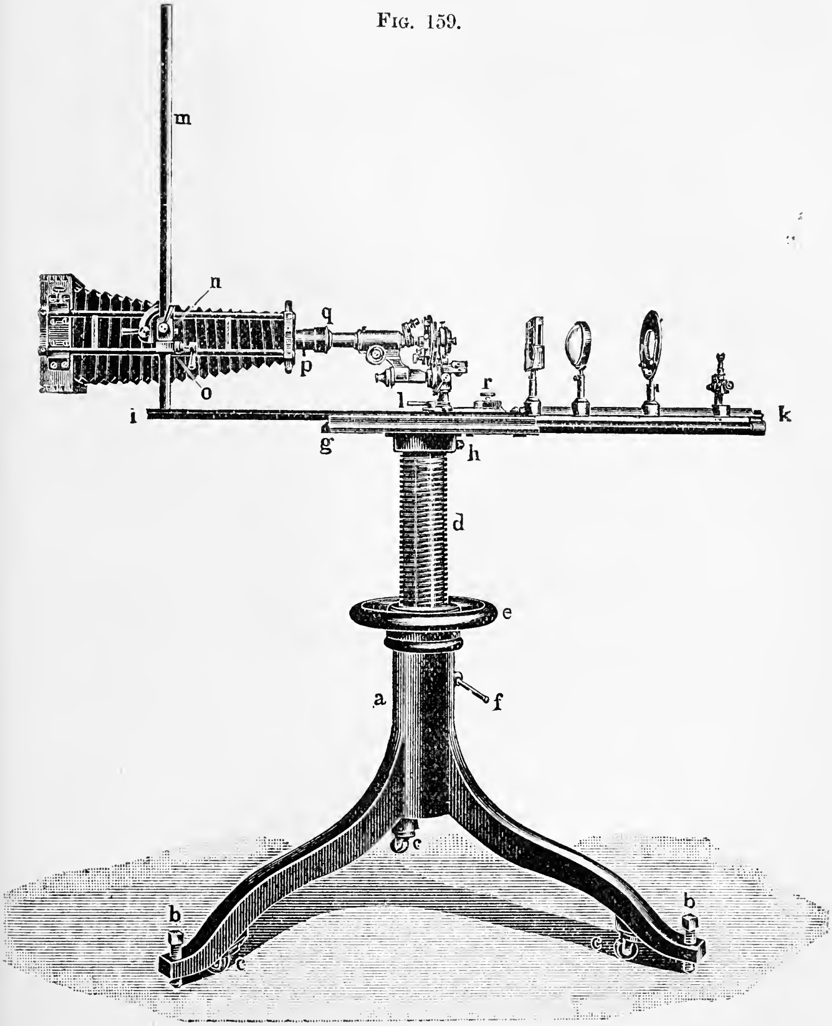
Gaylord's Complete Photomicrographic Apparatus.* — Under the above title Prof. Gaylord describes the most recent and most developed form of an apparatus originally invented by himself, and afterwards improved by C. Winkel.† The principal feature of the construction is the placing of the entire apparatus upon one support, at the same time connecting the camera and Microscope indirectly.

The support upon which the apparatus rests is a solid cast-iron tripod *a* (fig. 159) through the feet of which are levelling screws *b*, *b*, *b*. Directly at the back of the levelling screws are rollers *c*, *c*, *c*, by means of which the entire apparatus may be moved. Rising from the centre of the tripod is a shaft *d*, upon the surface of which is a coarse screw. Engaged in this screw, and supporting the shaft upon the neck of the tripod, is a large collar *e* in the form of a wheel. On the shaft *d* is cut a longitudinal slot in which a key is placed, and upon which the screw *f* impinges. By this arrangement, when *f* is loosened and *e* turned, the shaft *d* rises or falls according to the direction of rotation. The table *g* rests upon *d*, and is attached to it by a large pin fitting into its upper portion. The table is clamped fast by the screw *l*, and may be rotated in the short axis of *d* by loosening *l*. Attached to *g* are the camera support slide *i* and the illuminating bench *k*. The camera sup-

* Zeitschr. f wiss. Mikr., xvi. (1899) pp. 289–94 (3 figs.).
† Op. cit., xiv. (1897) p. 313. Cf. this Journal, 1898, p. 354.

port consists of a plate which slides in a dove-tail slot in the table *g*, and is clamped by the screw *l*. Rising from *i* is the carrier *m*, to which are clamped the camera rails swinging upon a pivot supported by a block *n* which is adjustable vertically on the carrier *m*. The position of

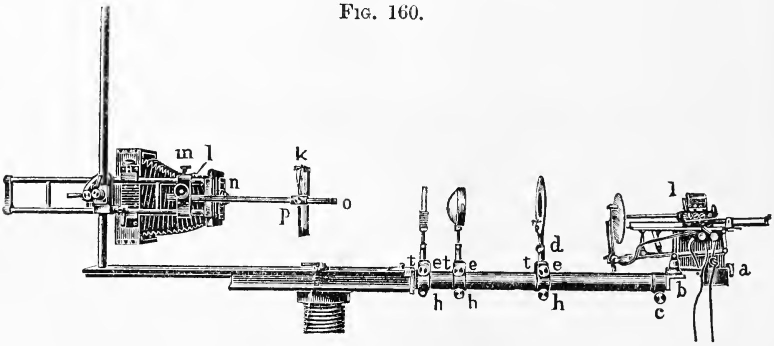
Fig. 159.



the camera may be changed from vertical to horizontal, or to any desired intermediate angle. The entire camera, in any position, may be adjusted to the height of the Microscope by raising or lowering the supporting block *n n m*. Beneath *n* is a second supporting block *o*, which is usually clamped fast after the camera has been adjusted; the screw of the block *n* may be loosened, the apparatus swung clear of the Microscope about the axis *m*, a stop adjustment between *m* and *o* indicating the proper position of the camera when swung back. The connection between the Microscope and the camera is accomplished by means of the usual double collar, but in this case the smaller ring is composed of two, the outer sliding over the inner, and having an Archimedean screw arrangement. To the outer ring is attached the pin *p*, and by rotating *p* the outer tube slides forward and enters the cap *q*. When the camera is to be swung away, the tube *p* is withdrawn, and the camera then swings clear. The Microscope is clamped fast to the table by a block and screw *r*.

The support for the illuminating apparatus consists either of a simple prismatic bar, stiffened by a tube as in fig. 159, or of a more complete arrangement as in fig. 160. Fig. 159 shows an attachment for acetylene gas; fig. 160 a Thompson 90° arc-light, which is especially suitable for photomicrography, as the negative carbon is always in the optical axis, so ensuring prolonged centering of the crater.

Fig. 160.

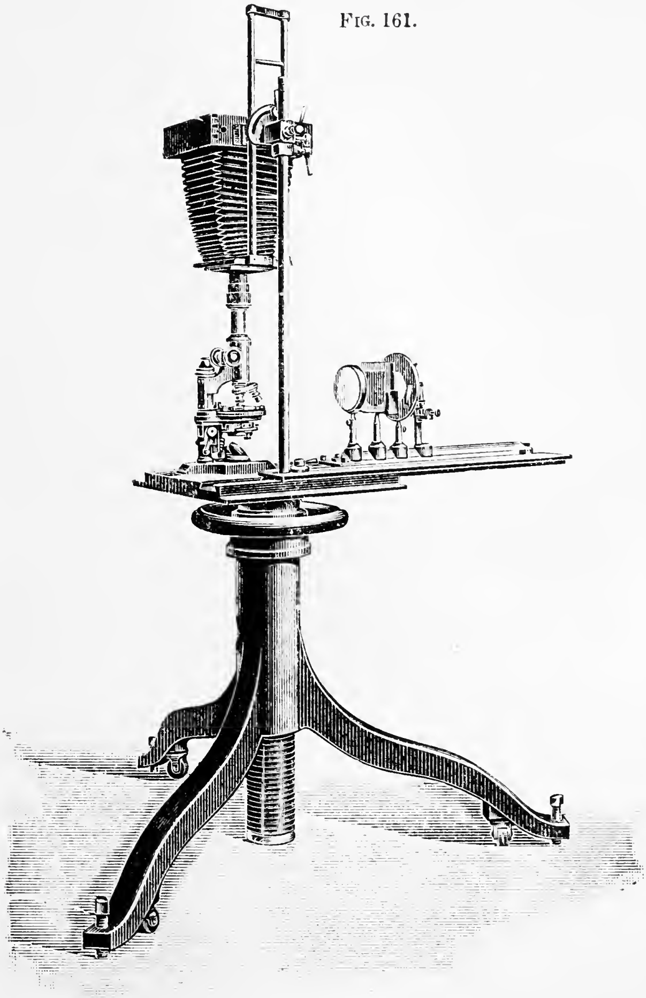


The illuminating support shown in fig. 160 consists of a strong brass tube fastened to the Microscope table by a bracket, and upon this tube are placed the various parts of the illuminating apparatus. The electric arc-light may be adjusted for height by rack-and-pinion; the head of the pinion is seen at *a*. The arc-lamp is supported by a bracket *b*, and may be revolved about a vertical axis at *b*. The bracket *b* is fastened to a tube which is fitted into the tube of the illuminating bench, which is split and reinforced by the clamping ring *c*. The arc-lamp may be swung under the bench by loosening *c*.

The various parts upon the bench (i.e the tube) may be adjusted vertically by a rack-and-pinion *d*, and transversely by a slide and screw *t*, *t*, *t*. On the upper surface of the tube is cut a longitudinal slot, and on each support is a small key *e e e*, which engages this slot and determines the position of the support. The supports are clamped fast by the screws *h*, *h*, *h*, and if it is desirable to dispense with any part of the illuminating apparatus, *h* is loosened, the key *e* raised, and the support swung beneath the bench.

In photography with low powers (microcolinears of Voigtländer and planars of Zeiss) the arrangement of fig. 160 is convenient; the Microscope is removed, the objective *n* attached directly to the camera front board, and a large movable stage *k* attached to the camera. The

FIG. 161.



stage proper is of glass, supported by a metal frame. The coarse adjustment is accomplished by moving the stage in the rod *o*, and is clamped in place by the screw *p*. The fine adjustment is by rack-and-pinion at *l*. The complete stage is detachable, and is fastened by the screw *m*.

For vertical photography the entire apparatus is arranged as in fig. 161 (the illuminating apparatus is not properly arranged), the screw support is lowered to the maximum (40 cm. fall), the camera is rotated to the horizontal position, then raised to the proper height, and the slide is pushed forward until the camera is over the Microscope. The further arrangements can be seen from the figure.

The inventor gives five reasons why the apparatus, in practice, offers certain advantages over those larger forms of apparatus which are divided between two tables.

(1) The apparatus, when once centered, may be moved by means of the rollers to any point desired.

(2) It may be used equally well in the horizontal or vertical position.

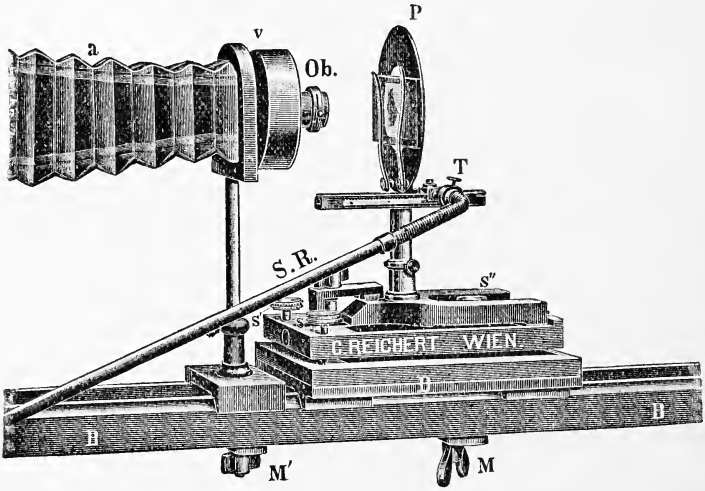
(3) It may be adjusted to any height convenient to the observer without disturbing the alignment.

(4) The entire apparatus may be centered to an independent source of light (sunlight, &c.) without disarranging the alignment.

(5) It takes up less floor space than the larger apparatus.

The inventor finds, after a year's experience, that no bad effects from vibration have been noted. Köhler's method of illumination is in process of adaptation. The idea of mounting on screws and rollers has occurred independently, but later, to the firm of Zeiss, who are applying it to some of their instruments.

Fig. 162.



Reichert's Low-Power Photomicrographic Apparatus.—The apparatus shown in fig. 162 is intended for low-power photomicrography, where a planar or colinear lens *o b* is used instead of an ordinary Microscope objective. The stage P, holding the object, is placed in a vertical position on a horizontal table. The object is brought into focus by moving the stage to and from the lens by rackwork; a pinion head which actuates this movement is seen at T; to this is attached by means of a flexible joint the rod S R; this enables focussing to be conveniently performed at the screen end of the camera.

FAVRE ET CHAUVET—**De la photographie microscopique.**
Lyon Médical, 1899, No. 17, p. 584.

TOISON, J.—**Présentation de Microphotographies.**
Comptes Rend. de l'Ass. des Anat. Paris, 1899, p. 19.

WALMSLEY, W. H.—**Photomicrography with Opaque Objects.**
Trans. Amer. Micr. Soc., XX. (1899) p. 189.

(5) Microscopical Optics and Manipulation.

KERBER, A.—**Beiträge zur Dioptrik.** (Treatise on Dioptrics.) Part 5.
Leipzig (Fock), 1899, 8vo, 16 pp.

(6) Miscellaneous.

DOUGLAS, C. C.—**Chemical and Microscopical Aids to Clinical Diagnosis.**
Glasgow (Maclehose), 1899.

GARBINI, A.—**Manuale per la tecnica del microscopio nelle osservazioni istologiche, anatomiche, zoologiche.** 4th ed. Milan (Vallardi), 1899, 8vo, 304 pp.

GOLDSTEIN, M. A., M.D.—**The Microscope, its Educational and Practical Value.**
Journ. of App. Micr., Sept. 1899, pp. 490–2.

MOREL ET SOULIÉ—**Manuel de technique microscopique.**
Paris (Soc. d'édit.), 1899.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Growing Anaerobes in Air.†—Mr. W. W. Alleger states that certain anaerobic bacteria (tetanus, symptomatic anthrax, malignant œdema) grow readily in glucose-agar stick cultures, without any precautions to preclude oxygen, if the tubes be placed in the steam steriliser for ten minutes, and then quickly cooled just before inoculation, although no growth, or only a scanty one, takes place in the same medium under identical circumstances if this precaution is omitted. The explanation given is that the free oxygen is driven out by the heat, and growth takes place before the medium has had time to reabsorb sufficient air to interfere with development.

Cultivation of Typhoid Bacilli from the Rose-coloured Spots.‡—Dr. Neufeld recommends the bacteriological examination of the rose-coloured spots in typhoid on account of its simplicity and rapidity. Out of ten cases he had only one negative result, and in that instance the other methods of diagnosis failed. He ascribes the success of his method to the use of liquid media. It is interesting to note that in one case the method was successful where the Widal reaction failed.

* 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, &c.; (6) Miscellaneous.

† Journ. Applied Microscopy, ii. (1899) p. 511.

‡ Zeitschr. f. Hyg. u. Infektionskr., xxx. No. 3. See Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 149–50.

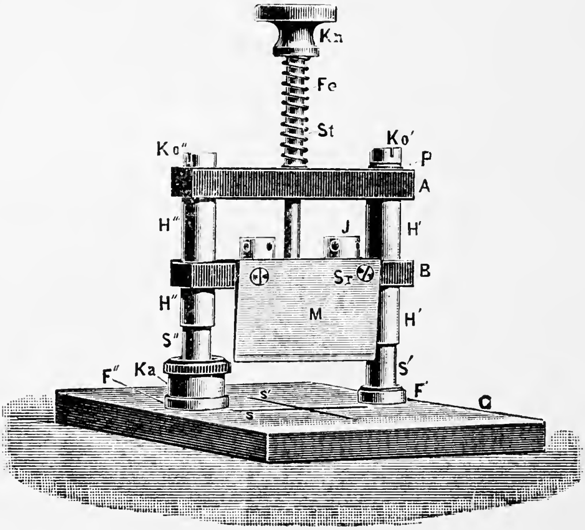
(3) Cutting, including Imbedding and Microtomes.

Virchow's Cutter for Dissection of Membranous Preparations.*— This apparatus of Herr Hans Virchow, of Berlin, is the result of difficulties often experienced by the author in getting truly cut sections with scalpel or scissors through embryo layers and such like objects. In addition to accomplishing the purpose of cutting to any desired orientation (so that serial sections may be afterwards made if desired), it permits the dissection of a preparation into parts without damage.

This apparatus (fig. 163) consists of four parts,—knife, glass plate, knife-holder, and frame.

(1) *Knife.*—The knife M takes the form of a blade 30 mm. in length and 20 mm. high. The lower side bears the edge, and the upper is fastened to the knife-holder by two screws S*r*. The holes for the screws are not circular but slit-shaped, being prolonged perpendicularly, so that in tightening the screws the knife is capable of a slight up and down adjustment. For it is necessary that the knife should be most accurately set, so that in the downstroke the edge should exactly reach the plate; in this way the object will be cut through without damage to the edge. The two screws J, inserted in the crossbar B, serve to complete this adjustment; they press on the knife-back, and are used to depress the knife, if necessary, after the screws S*r* have been tightened.

Fig. 163.



(2) The *Plate* G consists of a rectangular piece of plate-glass, 9 cm. long by 6 cm. broad, and bears three finely scored lines which serve for orientation of the preparation. Two of these lines *s* are parallel,

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 295–9 (1 fig.).

0·25 mm. apart (only one shown in figure), and are under the knife-edge; the third s' is at right angles to the first two. The object is set with regard to these lines, and its orientation attained either with the naked eye, or with lens or Microscope.

(3) The *Knife-holder* comprises the lower crossbar B, the two collars H′ and H″, and the rod S*t*, which is rigidly attached to B, and passes through an orifice in the upper crossbar A, and at its upper end bears a knob K*n*. When K*n* is depressed, this arrangement sinks, and is brought to rest by the collars H′ and H″ meeting the plinths F′ and K*a*; at the same moment the knife-edge just reaches the glass plate. The spring F*e* raises the knife-holder again when the pressure is removed.

(4) The *Frame* comprises the two pillars S′ and S″ and the upper crossbar A. Of these S′ is firmly secured to the glass plate, and to it belong the plinth F′ and the screw-head K*o*′. The pillar passes through an orifice in the crossbar A, which can be rotated round the pillar. But in order that A, in spite of this movability, should not be loose (which would render accurate knife-adjustment impossible), a spring is placed between the crossbar and the head K*o*′, and finds a support on the head, and presses the bar firmly down against the pillar, which is here broadened out. This spring P is a piece of brass concavely punched out, thus acquiring a twist and acting as a strong spring. It has an orifice through which the upper end of the pillar passes in order to receive the screw-head K*o*′.

The second pillar S″ is rigidly connected with A by means of the screw-head K*o*″, and can be swung out of its place over the glass plate. The means for accomplishing this are not shown in the figure, but will be understood from their description. The plinth F″ is immovable on the glass plate, and bears at its upper end a dove-tailed wedge, and the pillar at its lower end has a corresponding hollow which fits tightly on the wedge.

Thus, when desired, the pillar S″, the frame, knife, and knife-holder, can be rotated round the other pillar out of the way, and in this way the orientation of the object by vertical inspection can be attained.

Although the cutting is done by pressure, the author has found no disadvantage even with so difficult a material as yolk.

Starlinger's Apparatus for obtaining Perfectly Parallel Thin Brain Sections.* — This apparatus has been gradually perfected by Dr. Starlinger as an auxiliary to the Marchi method of brain dissection, and is in general use in the asylum laboratories of Lower Austria.

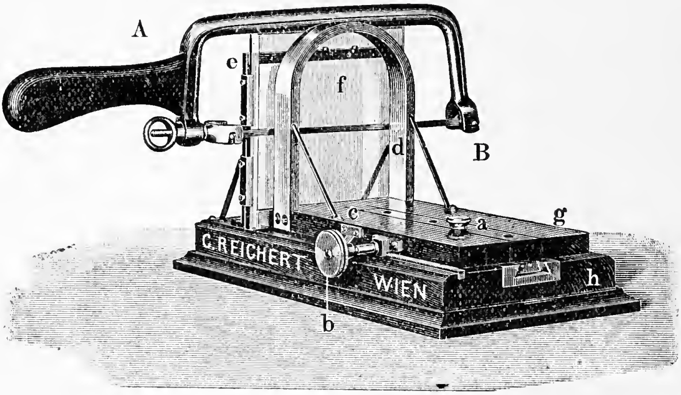
The author points out the importance of obtaining the complete section series in the pathological study of a brain, and how difficult, as well as uncertain, it generally is to obtain such. By his apparatus, a whole hemisphere, or an entire brain, can be easily cut into a complete series of sections. The action of the machine resembles that of a chaff-cutter.

The apparatus (fig. 164) consists of two parts, the knife A, and the framework B. The knife being thin and yielding, is set in a bow-saw frame. This peculiarity of the knife is of main importance, as every kind of stouter blade is unsuitable. The base *h* is a species of slide and carries a perpendicular glass plate *f* secured in a frame *e*. This

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 179-83 (1 fig.).

plate can be drawn out from the frame. The sliding part *g* carries a metal arch *d* (11 by 9 cm. in aperture), and its movement is controlled by a rackwork *b*. The distance of *d* from *f* is regulated by a micrometer *c*, and the screw *a* clamps *g* to *h*. When the slide has been set

Fig. 164.



at the desired thickness, the brain is pushed with the left hand through the arch *d* slightly pressed on the glass plate. The right hand grips the knife-handle and cuts through, leaning against the arch as a guide. The section usually adheres to the glass plate, which is then lifted out and immersed so that the section can be floated off. The author's custom is to make preliminary slices 1·5 to 2 cm. thick, and, after immersion in Marchi solution, to examine them for signs of degeneration; if any should be found, he cuts thin sections forwards or backwards as required. He invariably keeps his sections in strict serial order, and if any be removed for examination a sheet of blotting paper is inserted to mark the gap.

(4) Staining and Injecting.

Hæmatoxylin, Càrmine, and allied Substances.*—Herr P. Mayer makes a useful and timely contribution on certain pigments used in microtechnique. Though limited to a consideration of logwood, hæmatoxylin, hæmatein-cochineal, carminic acid, and carmine, the author's compilation is an excellent summary and bibliography of what is known of these pigments. References are given to these stains and to their combinations. Though none of the descriptions contain anything new, the information conveyed in these short articles is extremely useful from historical, technical, and bibliographical points of view, and a perusal will repay those who are interested and occupied with staining sections and tissues.

Flagella Staining.†—Prof. E. Zettnow records some recent improve-

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 196–220.
† Zeitschr. f. Hygiene u. Infekts., xxx. (1899) pp. 95–106 (1 fig.).

ments in the technique of flagella staining. Three mordants are described,—iron, alum, and antimony. Iron mordant is prepared by boiling for 5 minutes 20 grm. of tannic acid and adding iron oxide in slight excess. The solution is filtered, and when cold the mordant is ready for use. Pure iron oxide is prepared by precipitating iron chloride with ammonia.

Better results are obtained with alum-mordant, prepared by heating 10 grm. tannin with 200 ccm. in a water-bath at 55°–60°, and adding aluminium acetate. The mordant should be quite clear, but if cloudy, some more tannin solution should be added with the aid of gentle heat.

Antimony mordant is still stronger, and is prepared by dissolving 1 grm. of tartar emetic in some water, and then, together with 500 ccm. of a freshly prepared 5 per cent. solution of tannin, heating the mixture in a water-bath at 35°–40°. This mordant is opalescent when cold, but becomes clear on heating. Its action is increased (1) if the preparation be allowed to cool in the heated mordant until the latter begins to turn turbid; (2) if caustic soda be carefully added until the reaction becomes amphoteric or faintly alkaline. The cultures, 10–24 hours old agar or bouillon, are killed with 4 per cent. formalin; the latter immediately, while the former are washed off the agar with water and then killed. The solution is allowed to sediment for 24–72 hours, when it is decanted, and replaced by 1 per cent. formalin, and this in turn by pure water. The films are fixed with heat, washed with water, and then hot-mordanted for 5–10 minutes.

The films are stained with gold or silver. For the gold method the preparation is treated with gold chloride and heated until the solution vaporises. The silver solution is made from a solution of 4 grm. silver sulphate left in 500 ccm. of water for an hour. A quantity of this saturated silver solution is mixed with 30 per cent. aqueous solution of ethylamin, until a clear colour solution, which does not contain ethylamin or silver in excess, is obtained. A few (4–5) drops are placed on the mordanted preparation and heated until it steams. The bacteria and flagella are brownish-black. If not sufficiently stained, the process may be repeated or the colour further developed by means of gold chloride or mercury chloride. The latter gives the best results. The preparation is treated with 4–5 drops of 1 per cent. sublimate, and then reduced with a soda-pyrogallol solution. Soda solution (soda 2 grm., water 100 ccm.) 4 drops; pyrogallol solution (1 grm. pyro in 20 ccm. alcohol + 2 drops of acetic acid) 1–2 drops.

Injection-staining of Vascular Systems of Plants.* — Mr. R. A. Robertson has found the following simple method useful for class purposes and for private work. To the end of a large glass funnel a length of india-rubber tubing is securely wired. The funnel is fixed at a convenient height, and the lower end hangs free, eight feet or more in length; at the lower end is fixed a compressor clip. The stem (air-dried, preserved in spirit or fresh) has its end cut smooth and circular, and securely wired into the lower free end of the tube. In the case of delicate stems it is preferable to lute with balsam or asphalt. A beaker is placed beneath to catch the escaping fluid. The funnel and tube are filled with weak aqueous solution of fuchsin, the clip removed,

* Trans. and Proc. Bot. Soc. Edinburgh, xxi. (1897) pp. 54–6.

and the stem left for a few hours. If a living stem be used, the stain is chiefly confined to the conducting elements, and hence a differential staining is afterwards obtainable. The fuchsin is replaced by weak picric acid; this darkens and fixes the tissue, and when it comes through clear the stem is removed and transferred to 90 per cent. alcohol. In a few days it is decolorised and fit for sectioning. The sections may be contrast-stained with hæmatoxylin.

If required for dissection of the vascular system, the preparation may be immersed in, instead of injected with, weak picric acid, and then preserved in alcohol.

Romanowski's Staining for Bacteria.* — Prof. E. Zettnow has recorded his experience of Romanowski's eosin methylen-blue staining. He divides methylen-blues into two categories, those with green and those with violet-red reflex, and expresses his preference for the Höchster medicinal samples. The Höchster methylen-blue is made up to a 1 per cent. solution, and 1 drop of 5 per cent. caustic soda solution is added to 1 ccm. The eosin recommended is brom-eosin B A extra Höchst. in 10 per cent. solution.

The best proportion of the blue to the red solutions is as 2–1, and 2 drops of soda solution are added after mixing 2 ccm. of methylen-blue solution with 1 ccm. of eosin solution.

The cover-glasses are stained for 2–5 minutes, then washed with water, and examined. The preparations do not keep.

For differentiating and decolorising were used:—(*a*) for blood preparations, acetic-acid-methylen-blue (2 grm. methylen-blue in 400 ccm. water + 1 ccm. acetic acid); (*b*) for bacteria, eosin 1–500, or methylen-blue 1–10,000, or solution *a*.

Blood preparations were usually differentiated with one washing of the acetic-acid-methylen-blue. Bacteria were often treated two to six times with eosin solution, with a short washing afterwards with 1–10,000 methylen-blue. The specimens prepared by this method, as shown in the coloured plate, are extremely elegant.

Modification of the Aronson-Phillips Method for Staining Malarial Blood.†—Mr. E. G. Horder recommends the following modification of the Aronson-Phillips method:—

(1) *Preparation of Cover.*—Have ready a cover-glass in a pair of Ehrlich's forceps, and in another a piece of gutta-percha 1/2 in. square. Prick the ear and touch the drop with the edge of the gutta-percha. The latter is then laid flat and drawn across the cover-glass, commencing from the edge held by and parallel to the forceps. In this way 10 or 20 different smears can be made in a few moments.

(2) *The Heating.*—The cover-glass is passed 16–18 times through the flame of a spirit-lamp, the wick of which is 1/2 in. long.

(3) *The Staining.*—The best stain is made from Ehrlich-Biondi powder (Grübler). The solution, as given from Cabot in a note, is made by dissolving 15 grm. of the powder in absolute alcohol 1 ccm. and distilled water 6 ccm. The solnutio is made up as required. The time required for staining is two minutes or less.

* Zeitschr. f. Hygiene u. Infektionskr., xxx. (1899) pp. 1–18 (1 pl. with 9 coloured figs.).

† Lancet, 1899, ii. p. 889.

Differential Stain for Goblet-cells.* — Mr. C. Thom recommends that sections should be stained first in Mayer's hæmatein for 15–30 minutes, washed in 70 per cent. alcohol, and then stained on the slide in a solution of Bismarck brown in 70 per cent. alcohol for a very short time. The mucus-containing cells pick up the brown, all the other cells are stained with hæmatein.

Method of obtaining a Black Reaction in certain Tissue Elements of the Central Nervous System.†—Dr. W. F. Robertson obtains a black reaction with sections of central nervous system, by immersing pieces of tissue in a solution composed of 5 per cent. of formalin to a 1 per cent. solution of platinum bichloride. The bottle should not be too tightly corked, as air must not be excluded. In from 1 to 3 months the piece of tissue begins to blacken. The immersion is continued for some weeks longer, and during this period the bottle should be more tightly corked, and if necessary the solution renewed.

When ready for examination the piece is soaked in dextrin solution for some hours, then sectioned, and mounted in balsam in the usual way.

The chief structural features revealed by this method are:—(1) fibres in the wall of intracerebral and medullary vessels; (2) primitive fibrils of the protoplasm of the nerves; (3) certain granules in the nucleus of the nerve-cell; (4) special cell elements.

(5) Mounting, including Slides, Preservative Fluids, &c.

Method of Mounting Fungi in Glycerin.‡—Mr. A. Lundie meets the difficulty of expelling the air and properly teasing out the filaments when mounting fungi like *Eurotium*, &c., in the following ingenious manner. A piece of *Eurotium* is placed on a slide, wetted with chloroform, strong glycerin added, and a cover-glass imposed. By heating the preparation over a Bunsen flame the chloroform is made to boil and so drive off the last traces of air. The bubbles of chloroform vapour, in passing out, scatter the hyphæ and tease out the preparation, without breaking it up as is done when needles are used.

Fixation after Methyl-blue.§—Prof. A. S. Dogiel finds that in using Bethe's ‖ method of fixation, it is not only unnecessary but distinctly hurtful to add hydrochloric acid to the solution of acid ammonium molybdate, and it is also unnecessary to add peroxide of hydrogen, or to cool the molybdate while the preparations remain in it. His modified formula runs as follows:—Place the sections in a 5–10 per cent. solution of acid ammonium molybdate for 12–18 hours at a temperature of 17° to 19° C.; wash in distilled water for half an hour, dehydrate, clear, and mount.

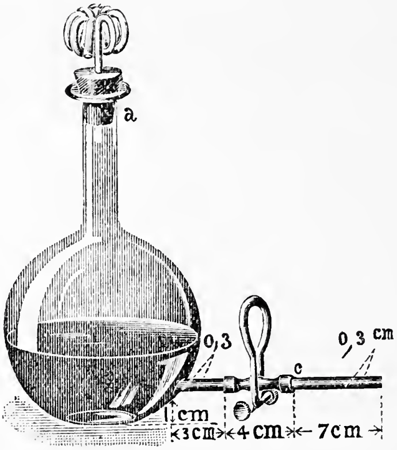
(6) Miscellaneous.

Flask for Preserving Fluid and Semifluid Nutrient Media.¶—Dr. L. Heydenreich has given up cotton-wool as stopping for flasks,

* Journ. Applied Microscopy, ii. (1899) p. 497.
† Scottish Med. and Surg. Journ., iv. (1899) pp. 23–30 (2 pls.).
‡ Trans. and Proc. Bot. Soc. Edinburgh, xxi. (1899) p. 159.
§ Zeitschr. f. wiss. Zool., lxvi. (1899) pp. 361–4.
‖ Arch. f. Mikr. Anat., xliv. (1895); Anat. Anzeig., xii. (1896).
¶ Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 149–56 (5 figs.).

and has adopted Hest's method, which consists in using a bunch of tubing with sixteen bends. The tubes are made of brass or copper, are drawn out, and are without join or soldering. The measurements given are,—wall about 0·75 mm., bore 1–3 mm. The length of a single bend is about 1·5 cm. The construction of the bunch is easily gathered from

Fig. 165.



the illustrations (figs. 165–167). It will be seen that one end is long, the other short, and that both point downwards. The long end is inserted in the rubber plug which fits into the neck of the flask (fig. 165). At 1 cm. above the bottom of the flask, projects a tube

Fig. 166.

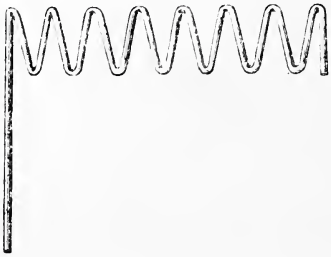


Fig. 167.

3 cm. long, with a lumen of 3–4 mm. The end of this tube is slightly expanded, and to it is connected a rubber tube closed by a pinch-cock. Through this tube fluid is withdrawn as desired.

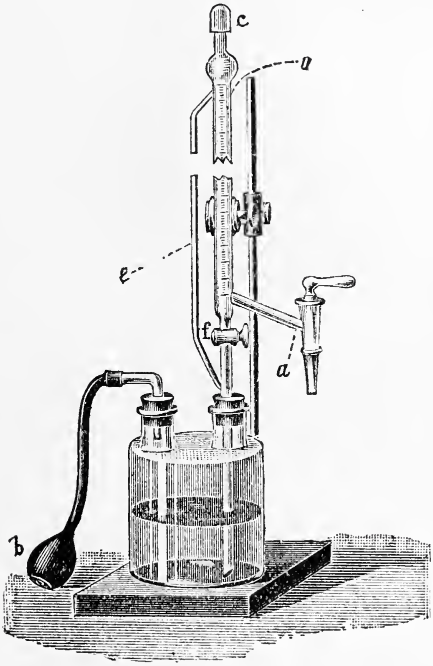
Burette for Bacteriological and other Titrations.*—Dr. L. Heydenreich describes a burette which possesses the advantage of measuring

* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 145–9 (2 figs.).

off a definite quantity of fluid automatically, and of allowing any surplus to run back into the flask.

As will be seen from the illustration (fig. 168) the burette proper is quite simple. It is graduated in divisions of cubic centimetres and tenths, the zero 0 being at the top. With the main tube two lateral tubes are connected, *e* and *a*. The latter comes off at an angle of 70°, and is provided with a tap. The upper end of *e* opens into the burette just above the zero mark, while the lower end joins the main tube below the stop-cock *f*. Immediately above the zero mark there is a bulbous expansion of the burette, and the top is covered with a cap *c*.

Fig. 168.



The fluid to be measured is contained in a Woulf's bottle with two openings. Through one of these passes the lower end of the burette; through the other, a glass tube connected with a rubber tube having a ball at the free end. In the ball is a small hole. The fluid is forced from the bottle into the burette by squeezing the ball *b* several times. While this is being done, the tap *f* is open and a finger placed over the hole in the ball. When the fluid has risen up above the zero mark and perhaps into the bulb, the tap *f* is closed. The residue above 0 then runs back into the flask through the side tube *e*. The desired quantities are removed through the side tube *a*.

The apparatus can be made of any desired size, the most convenient being 25–30 ccm.

Apparatus for Carrying Samples of Water for Bacteriological Examination.*—Dr. L. Heydenreich describes an apparatus used in the transport of samples of water. It is cylindrical, stands on short feet, and is provided with a lid and handle. From the lower edge projects a

Fig. 169.

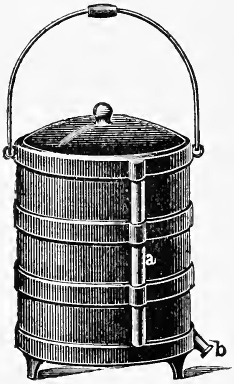
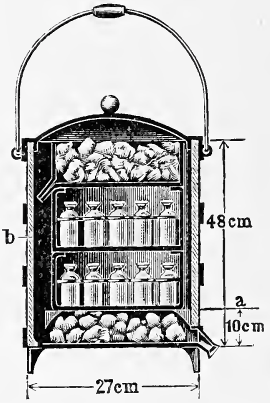


Fig. 170.



short nozzle for the outflow of melted ice-water. The bucket is made of metal, is lined with felt, and covered with oilcloth. Its internal arrangements are three superimposed frames or trays, the uppermost for ice, the lower two for bottles. Each tray will hold ten bottles. At the bottom of the upper tray is a short pipe, through which the melted ice escapes to the bottom. The free end of this pipe projects into the groove *a* (figs. 169, 170).

Fig. 171.

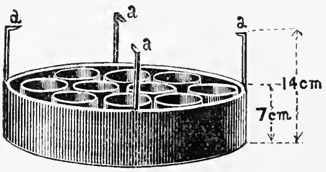
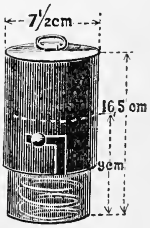


Fig. 172.



In fig. 171 is a pan or tray with details and measurements. The upright rods with pieces turned in at right angles support the tray above, and serve also for the removal of the tray itself.

A description of another metal case for bottles requiring special care is also given (fig. 172). The chief points in this apparatus consist in

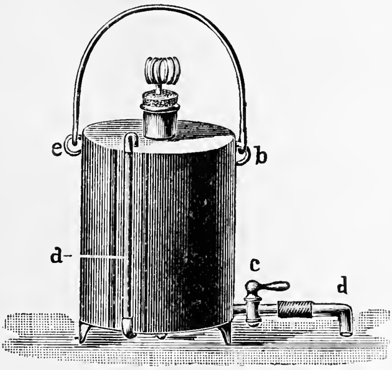
* Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 163–7 (4 figs.).

the bayonet-joint by which the lid is fixed on, and the spring at the bottom which prevents the lid from slipping.

Sterilising Apparatus.*—The apparatus described by M. J. Hausser consists of a porcelain funnel with a perforated plate, and fitted into the mouth of a kind of separating funnel, which in its turn fits into the mouth of a flask connected with a filter-pump. All parts of the apparatus are heated to 125°, and boiling water and kieselguhr are run on to a double layer of filter-paper placed on the plate of the funnel. In this way a layer of moist kieselguhr, 0·5–1 mm. thick, is deposited. A layer of kieselguhr which does not allow the passage of air under a pressure of 1 kilo. acts as a perfect steriliser to any liquid filtered through it, whilst it permits the passage of 15–20 times as much liquid as does an equal surface of porous porcelain.

Sterile Water Apparatus.†—Dr. L. Heydenreich describes an apparatus for making and keeping ready for use sterile water (fig. 173). It is

FIG. 173.



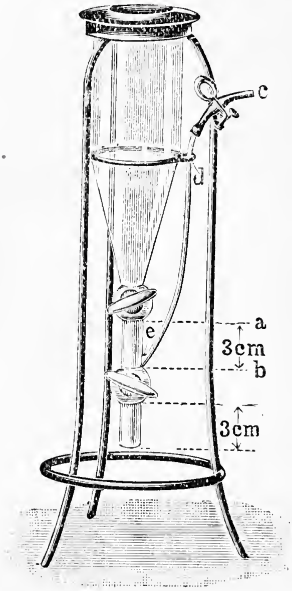
made of metal (copper or brass), its diameter is 18 cm., its height 20 cm., it holds about 5 litres, its inner surface is tinned, and it stands upon three legs. Close to the bottom is an outlet tube, 3·5–4 cm. long and 3–4 mm. wide. This is provided with a tap, and its free end is expanded to grip a rubber tube. At the top is a short neck closed with a Hest's stopper (see figs. 165–167). The apparatus is also provided with a water-gauge tube, and this is protected by a sliding shutter (not shown in figure). The apparatus is filled up to the neck with water, and then sterilised in a Papin's digester for 20–30 minutes at 135° (two atmospheres). This apparatus will be found very convenient for bacteriological and other investigations.

Funnel for Collecting the Sediment of Water intended for Bacteriological Examination.‡—Dr. L. Heydenreich describes a funnel for obtaining the sediment of water for bacteriological examination. The

* Bull. Soc. Chim., xxi. (1899) pp. 250–3. See Journ. Chem. Soc., 1899, Abst., ii. p. 569.
† Zeitschr. f. wiss. Mikr., xvi. (1899) pp. 156–7 (2 figs.).
‡ Tom. cit., pp. 178–9 (1 fig.).

hopper holds 2–3 litres, has very sloping sides, and a pipe with two stopcocks (fig. 174). The bore of the pipe is 0·6 cm. wide, and the lumen of the tapways is the same. The space between the taps is connected with a pipe *e d c*, the bore of which is 0·3–0·4 cm. in diameter. This pipe is supported at *d* by an attachment to the stand, and its free end is connected with a piece of rubber tube closed by a Mohr's pinch-cock with Leiss's hook.

Fig. 174.



The taps are all closed when the water is poured in. When the sediment has collected at the lower end of the hopper, the tap *a* is opened. The sediment-water, however, does not pass into the pipe until the pinch-cock is nipped. The tap *a* is then closed, and the contents are allowed to escape into a porcelain dish by opening the tap *b*.

The illustration shows the chief measurements.

Bacteriological Diagnosis of Plague.*—Dr. C. B. Stewart describes the methods adopted at the Bombay Research Laboratory for diagnosing the plague in man or animals, and for testing a plague culture. The remarks apply only to recent cultures on agar or in bouillon at the ordinary room temperature, the optimum being 74° F. The colonies on agar appear in 24 to 48 hours, and, when touched with a wire, slip about on the surface. After one or two days' incubation, agar slants which have been smeared with 0·1–0·2 ccm. of broth culture show the "ground-glass" appearance when inspected from underneath.

In broth the stalactitic growth is held to be characteristic of the plague microbe.† It has been found that the addition of a little cocoanut oil or of glue, before sterilisation, facilitates the formation of stalactites by affording *points d'appui*. Another phenomenon which appears to be characteristic consists in growth along and up the glass rod which has been used for inoculating the flask. When the upward growth reaches the surface, it spreads out, covering the surface with colonies, from which stalactitic downgrowths soon depend. The broth remains quite clear.

The microbe stains readily with anilin dyes, but not by Gram's method. The bipolar staining is not constant, but bipolar spots are easily detected in living and unstained specimens. Suspensions of plague microbes in water dry as a bluish film on a slide. The microbe is polymorphic; sometimes it resembles a coccus or diplococcus; sometimes a short stumpy bacillus, with rounded ends; diplobacilli are frequent, and sometimes there are short chains.

* Brit. Med. Journ., 1899, ii. pp. 807–8. † Cf. this Journal, 1897, p. 327.

Microscopical Diagnosis of Anthrax.*—Herr Olt gives the following method for the microscopical diagnosis of anthrax:—3 grm. of safranin are dissolved in 100 grm. of nearly boiling water. When cold the solution is filtered. The film is made in the usual way, with blood or spleen-juice. The staining solution on the cover-glass is heated to boiling for ½–1 minute. The cover is then washed in water and examined.

In connection with sending samples of anthrax by post, &c., for examination, the author remarks that it is improper to pack anthrax material in glass or metal cases, as it is likely to putrefy. He advises that a little blood or spleen-juice should be dropped on a piece of well-boiled potato. This, packed in a matchbox which is not air-tight and covered with paper, preserves the moisture sufficiently. This may be despatched at once, or retained for 2–24 hours, and thus give an opportunity for vegetating and sporing.

Preparation of Vegetable Casein for Experimental Purposes.†—For studying the extracts, the preventive and bactericidal properties of leucocytes, an effective pyogenic agent is necessary. This was found in 1890 in vegetable casein, which is now prepared in a pure condition by the following method described by M. J. Colard. A stream of water is run through wheat flour enclosed in a bag until the stream comes out quite clear, indicating that all the starch has been removed. In this way 150 grm. of wet gluten are obtained from 1 kgrm. of flour. 100 grm. of gluten are macerated in 4 l. of water containing 4 grm. of caustic potash per litre. When all the gluten is dissolved, the fluid is decanted or filtered through a cloth, and then acetic acid in slight excess is added. The purified gluten is thus reprecipitated; in winter the precipitation may be hastened by gently heating the fluid. The vegetable fibrin is next removed from the gluten by extracting successively with 60 per cent., 80 per cent., and 100 per cent. alcohol. The insoluble residue, which is vegetable casein, is dried carefully. From 1 kgrm. of flour 20 grm. are obtained. As a pyogenic agent it is used in a feebly alkaline solution prepared by digesting the pure product in 0·5 per cent. potash solution at 37°. It is then reprecipitated with dilute HCl, and redissolved in water to which a few drops of caustic soda solution have been added. To excite suppuration, 8–10 ccm. of the alkaline solution at 5 per cent. to 10 per cent. are injected into a pleural sac. In about two days an equal quantity of pus may be withdrawn.

Blood Stains and the Guaiacum Test.‡—Mr. E. Schaer states that blood stains are easily dissolved out in a 70 per cent. aqueous solution of chloral hydrate; if old, the process is facilitated by moistening the stain with dilute acetic acid. And inasmuch as guaiacum (and also guaiaconic acid) is soluble in the chloral solution, the guaiacum blue reaction is much simplified.

Filling Fermentation-Tubes.§—Mr. W. W. Alleger fills fermentation-tubes with hot bouillon, from which the air has been expelled by a

* Deutsche Tierärzt. Wochenschr., 1899, No. 1. See Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1889) pp. 157–8. † Ann. Inst. Pasteur, xiii. (1899) pp. 735-6.
‡ Amer. Mon. Micr. Journ., xx. (1899) pp. 274–83.
§ Journ. Applied Microscopy, ii. (1899) p. 496.

stay of some minutes in the steriliser immediately before use. This procedure practically diminishes the trouble arising during sterilisation from a large air-bubble in the closed end of the tube.

Modification of Koch's Method for making Gelatin Plates.*— Dr. L. Heydenreich finds that it is more convenient to reverse Koch's method and place the ice-pan above the gelatin to be cooled. The same kind of tripod-leveller is used.

Widal's Reaction with a Measured Quantity of Blood.† — Dr. R. L. Pitfield has found by experiment that a disc of filter-paper (Schleicher and Schüll's 598) 8 mm. in diameter will absorb 1 ccm. of blood from a drop on the finger. If dried, the blood may easily be dissolved out in 10 ccm. of water, bouillon, salt solution, or bouillon culture of typhoid, and thus a dilution of one to ten of the blood obtained.

New Procedure for Inoculating Animals with Rabies Virus.‡— Dr. J. Lebell recommends the following procedure which possesses all the advantages and none of the disadvantages of trepanning and subdural infection. The fixed virus is injected into the spinal canal. An ordinary Pravaz syringe is used, and the needle inserted between the spinous processes of the first and second lumbar vertebræ. Two or three drops of an emulsion of the fixed virus is sufficient. The injection site should be freed from hair, disinfected with a one per thousand sublimate solution, and after inoculation covered with collodion. The rabbit dies on the seventh or eighth day. If the procedure be properly carried out there are no complications.

Black Anilin Ink.§—Dr. L. Heydenreich gives the following formula for preparing anilin black ink which combines chemically with fibres and does not fade. (A) Crystallised copper chloride 4; sodium chloride 5; ammonium chloride 3; distilled water 30. (B) Anilin hydrochlorate 40; gum arabic 15; water 95. The two solutions must be kept apart and in the dark. When required for use equal bulks are mixed together. If one solution only be preferred, then, before mixing with solution A, 100 hydrochloric acid is added to solution B, and the whole boiled for some time. Though intended to dye filter-papers so as to contrast with white or coloured fibres in the filtrate, the ink may be used for other articles, such as linen. Filter-papers are to be soaked in the ink for two days, dried, steamed for 10–15 minutes, washed in soapsuds, and finally in distilled water.

* Zeitschr. f. wiss. Mikr., xvi. (1899) p. 153 (2 figs.).
† New York Medical Record, 1899, i. pp. 659–60 (1 fig.).
‡ Centralbl. Bakt. u. Par., 1te Abt., xxvi. (1899) pp. 221–2.
§ Zeitschr. f. wiss. Mikr., xvi. (1899) p. 177.

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 18TH OF OCTOBER, 1899, AT 20 HANOVER SQUARE, W.,
THE PRESIDENT, E. M. NELSON, ESQ., IN THE CHAIR.

The Minutes of the Meeting of June 21st 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, and the thanks of the Society were voted to the donors.

	From
Peragallo, H. and M., Les Diatomées Marines de France. Part I. (8vo, Paris)	*The Publisher.*
Tempère, J., Le Diatomiste. (2 vols. 4to, Paris, 1890–6)	*The Author.*
Häcker, V., Praxis und Theorie der Zellen- und Befruchtungslehre. (8vo, Jena, 1899)	*The Publisher.*
Fischer, Alfred, Fixirung, Fārbung und Bau des Protoplasmas. (8vo, Jena, 1899)	*Ditto.*
Newman, Geo., Bacteria. (8vo, London, 1899)	*The Author.*
Journal of the Board of Agriculture. Vol. vi. Nos. 1, 2. (8vo, London, 1899)	*The Board of Agriculture.*
Reichert, C., A Guide for the use of the Micro-Photographic Apparatus as constructed in the Optic-Mechanical Manufactory of C. Reichert. (8vo, Vienna, 1899)	*The Publisher.*
A Microscope by Cary	*Mr. Frank Gleadow.*

The President called attention to an old Microscope by Cary, presented to the Society by Mr. Gleadow. He hoped to be able shortly to find the name of the inventor of this instrument, and regretted that he had for the moment lost the reference. It was a very interesting addition to the Society's collection, and their special thanks were due to the donor. It had been already figured in the Journal for 1898, p. 474, fig. 82.

The President said that the Finance Committee had reported that a great many subscriptions for the current year remained unpaid. He thought it would only be necessary to mention this to get the matter put right.

Messrs. Watson and Sons exhibited a new School Microscope, which, contrary to the usual rule, was provided with a diagonal rack and pinion for coarse adjustment, and no fine adjustment. The special idea in view was to provide a thoroughly strong and well made instrument at a low price (see p. 649).

They also exhibited a new form of eye-piece named the "Holoscopic," which was fitted with an adjustment to render it either over or under-corrected, and suitable for use with both achromatic and apochromatic objectives (see p. 651).

Dr. Dallinger was very glad to find the makers were beginning to realise in earnest that there was a want for something which was both good and cheap. He had seen this little instrument, and thought it would admirably answer the purpose for which it was intended; and the coarse adjustment was so well made that he found it worked with ease in focussing a 1/8 in. objective.

The President thought it was a good sign that they now had a Microscope of this kind with only a coarse adjustment in place of the sliding tube and fine adjustment; an old one which he had in his possession for many years had certainly proved a very good tool in his hands. This Microscope was strongly made and well fitted, and would no doubt be found a very useful instrument.

Dr. Measures exhibited a new Microscope for photomicrography by Zeiss, the chief features of which were a wide body-tube and a new form of fine adjustment, which admitted of the arm being of any length without throwing the weight upon the fine adjustment screw. The milled head was graduated to 0·002 mm.; an entire revolution raised or depressed the tube 0·04 mm.; and the screw was protected completely from any injury from overwinding.

Dr. Dallinger said it was a matter of interest to find a firm like Zeiss attempting to reduce the speed of the fine adjustment. The way in which they had done this was most ingenious; for though the thread was the same as before, the manner in which it was acted upon was entirely different. It was effected by means of an endless screw which acted on the micrometer screw; and as the milled head which worked the endless screw moved the micrometer screw only slightly by each revolution, an extremely slow motion was obtained, being only the 1/635 in. for every revolution of the milled head working the endless screw. They had always protested at the Royal Microscopical Society against the fine adjustment having to carry so much weight, and they were therefore very glad to find that this one only had to lift one-fifth of the weight usually put upon the fine adjustment of an ordinary Microscope, but this arose from the fact that the body was made of aluminium, not brass.

The President said their thanks were due to Dr. Measures for showing this Microscope. The method adopted was certainly a novel way of slowing down the fine adjustment, and it was the first time he had seen an endless screw used to reduce the motion. The reduction of the weight upon the thread was also a very important improvement, and another good feature was the length of the arm. He regarded these improvements as a concession to the English idea, and an admission that some improvement was, after all, possible on the Continental model.

The President said he had another Continental model to bring before them,—Reichert's Austrian model, a new feature of which was that the fine adjustment screw worked upon a lever, and this in turn upon another lever, with a screw adjustment to take up the wear. The indicator to the fine adjustment, instead of being fixed, as usual, was movable, so that it could be turned to zero at any time required; this greatly facilitated the reading of the divisions on the head of the fine adjustment screw. The instrument was fitted with the English standard substage, a cut stage and sliding bar, and the trunnion axis was placed above the stage to ensure a better balance. Two other Microscopes of Reichert's were also exhibited, to one of which attention was particularly directed as being a Student's Microscope with no fine adjustment, but in which his suggestion had been carried out of using an ordinary dissecting loup as a substage condenser; this could be taken out and used as a dissecting lens if so desired. Another Microscope of similar design but larger size was also shown.

Mr. Conrad Beck did not think there was anything new in having the setting-up screw for the coarse adjustment. He also asked the President what was understood to be the size of the English standard substage.

Dr. Dallinger said that Reichert claimed to be the only Continental maker who sprung his Microscope fittings, so that, as in English instruments, they could be readily compensated for wear.

Mr. Watson Baker was very glad indeed to know that the Continental maker had adopted the standard size for his substage fitting. The constant variations met with were the distraction alike of the makers and the microscopists. If any one could persuade other Continental opticians to move in this direction, he would earn the gratitude and lengthen the lives of English opticians and English microscopists.

Dr. Measures said that Reichert was certainly not the only one who made an adjusting screw for the coarse adjustment. Zeiss also has had such a system in use in all stands for over four years.

Dr. Dallinger thought it would be interesting to know when this was first done, because at the present time Reichert gave out that he was the only one who had done it.

On the motion of the President the thanks of the Society were voted to Dr. Measures and Mr. Reichert for these exhibits.

The President exhibited a Watson's Edinburgh Student's Microscope which during the vacation had been fitted with the new stepped rackwork. He asked the Fellows to try it and detect for themselves that there was no loss of time, even though the pinion was pressed but lightly into the rack.

The Microscope had also been fitted with Watson's new fine adjustment to the substage, the head of the pinion being brought out clear of the stage.

The President said that he would mention for the benefit of manufacturing opticians that a French chemist had introduced an alloy of aluminium and tungstate; this was now used by engineers in the manufacture of motor cars, and he had little doubt that it would prove very useful in Microscope construction. It possessed some valuable qualities that aluminium did not have, and it was nearly as light as that metal. He thought that the heads of the coarse adjustment pinion, as well as the body-tubes, might always be made of this alloy with advantage, especially when their weight was carried by the threads of a micrometer screw fine adjustment without the interposition of some sort of a lever.

He next exhibited a Dissecting Stand by Andrew Ross, and said that this stand was modelled on two older forms, of which the first was Ellis's Aquatic Microscope, made by J. Cuff (1755), and the other was Valentin's Microscope, made by Andrew Ross (1831). The instrument was about forty-five or fifty years old, and was still a thoroughly good working instrument. The lenses were all non-achromatic, but nevertheless gave very good images.

Mr. C. Lees Curties, being asked by the President to describe some photomicrographs in natural colours exhibited in the Krōmskōp, said that Mr. E. R. Turner, who had made the apparatus and photographs, was in the room and would no doubt say a few words about them.

Mr. Turner said he had not come with any intention of speaking, but would make a few remarks which might be of interest. Mr. Ives' process of colour photography was fairly well known to most persons who took an interest in such things; it consisted in taking three negatives through colour screens, each of which consisted of a colour record of the original subject. If positives from these negatives were put into the Krōmskōp, an instrument which would optically re-combine the three images, each illuminated with its own colour, the result was a single picture in the natural colours. It was an optical illusion and not a concrete photograph in colours, and the only new thing about those exhibited in the room was in applying the process to photomicrography and taking the pictures stereoscopically. In doing this, ordinary objectives were used in conjunction with a pair of reversing prisms, and the object was photographed through red, green, and blue-violet screens. These, when properly mounted, and when put into the Krōmskōp, recombined the three colours of which the negatives were records, and represented the object in the colours which it originally expressed.

The thanks of the Society were, upon the motion of the President, cordially voted to Mr. Turner for describing this process, and for bringing the photographs and the apparatus for them to see.

Dr. Hebb said another paper had been received from Mr. Millett, being Part VI. of his communications on the Foraminifera of the Malay Archipelago. It consisted largely of descriptions and lists of species, and being too technical to read to the Meeting, would be taken as read, but would be printed *in extenso* in the Journal.

The thanks of the Society were unanimously voted to Mr. Millett for his paper.

Mr. F. Enock gave an extremely interesting account of his observations on the life-history and habits of British Trap-door Spiders, illustrating the subject by a large number of original lantern views.

Mr. Vezey said, as he was somewhat responsible for Mr. Enock's appearance there that evening, he should like to express the obligation which he felt personally, and he felt sure he might add that of the Society, to Mr. Enock for this very interesting and instructive communication. His patience in carrying out his investigations was well known, and all naturalists owed him a debt of gratitude for the very careful way in which he had worked out every detail. Mr. Enock had also put his facts before the Meeting in such a charming way that every one had listened to him with pleasure, and he illustrated his subjects so well that it was always a treat to see his pictures. He had great pleasure in moving that the best thanks of the Society be given to Mr. Enock for his very interesting address.

The President felt sure that all present had enjoyed a great treat that evening, not only in listening to the very interesting lecture that had been given, but in seeing the very beautiful pictures by which the subject had been illustrated.

A very hearty vote of thanks to Mr. Enock was then carried by acclamation.

Mr. Enock, in responding, said it was always a pleasure to come down there and help his friends. He might say that he had kept under observation fifty pairs of these spiders, and only in one case did the male escape being killed by his mate. He had captured a pair of these spiders that morning on Hampstead Heath, and had brought them alive to the Meeting for the inspection of any one who wished to see them.

The following Instruments, Objects, &c., were exhibited:—

The President:—A Microscope fitted with new Stepped Rackwork Coarse Adjustment and Watson's new Fine Adjustment to the Substage; and a Dissecting Stand by Andrew Ross.

Mr. C. Baker:—Photomicrographs taken by the Ives Process and the Apparatus by which they were taken; and three Microscopes made by Reichert.

Mr. F. Enock:—A series of Lantern Slides illustrating his discourse on British Trap-door Spiders.

Dr. Measures:—A Microscope for Photomicrography, Model 1899, made by Carl Zeiss.

Messrs. Watson and Sons:—The "School" Microscope; "Holoscopic" Eye-pieces.

New Fellows:—Mr. A. A. C. E. Merlin, and Right Rev. Dr. W. P. Swaby.

MEETING

Held on the 15th of November, 1899, at 20 Hanover Square, W.
The President (E. M. Nelson, Esq.) in the Chair.

The Minutes of the Meeting of 18th of October, 1899, were read and confirmed, and were signed by the President.

The following Donation to the Society, received since the last Meeting, was announced, and the thanks of the Society were voted to the Donor.

	From
Transactions of the Jenner Institute of Preventive Medicine. (8vo, London, 1899)	*The Jenner Institute of Preventive Medicine.*

Dr. Hebb called attention to the volume of the Transactions of the Jenner Institute, which he thought would be of great interest to any one who was engaged in bacteriological work.

Mr. C. Lees Curties exhibited a new form of portable Microscope by Leitz, which was made with a folding V-shaped foot, and a stage which fitted into a socket, from which it could easily be removed to enable the instrument to be packed away into a very small space. The body was not made to incline, but was furnished with both coarse and fine adjustments, and the stage was fitted with a modified form of Abbe condenser with iris diaphragm. There was nothing specially new, either in the pattern or in the accessories, beyond the means contrived to secure extreme portability.

The President thought this instrument was likely to be of much use to any one who wanted something very portable. Its great compactness was effected in a simple and ingenious manner, whilst the working parts were well made and finished.

The President read a short note descriptive of three simple hand-Microscopes on the Coddington principle, sent for exhibition by Mr. Edward Swan (see p. 643).

A Microtome, sent by Prof. J. W. Groves, was exhibited, and a letter, describing the modifications made by the exhibitor, was read by the Secretary, in which Prof. Groves says, "By experience in vegetable work, I found that the frequent changing of material caused the screw at the lower end of the tube of the ordinary hand-microtome to wear out pretty rapidly. I therefore got Swift to make me this little machine, in which the screw which raises the material is attached to an outer tube which slides up over the ordinary tube in grooves, and having reached the top, is turned slightly to the left and clamped by a small screw, which serves the double purpose of preventing the outer one being inadvertently turned round, and also keeps it pressed down, so that the material shall rise truly. The material can be changed more rapidly than in most instruments of the kind, as well as with less wear."

The thanks of the Society were voted to Mr. C. Lees Curties, to Mr. Swan, and to Prof. J. W. Groves, for their exhibits.

The President called the attention of the Fellows present to five photomicrographs of the larvæ of gnats, taken from life by Mr. J. T. Holder. They were very beautiful productions, and particularly remarkable as having been taken, not from mounted specimens, but from the living objects.

The President said it had often been remarked there that there was nothing new under the sun, and he had lately come across an old Gillett condenser, dated July 20th, 1849, which had an adjustment to it. They all thought, a short time ago, that a condenser with an adjustment-collar was something quite new; but here it was in this old piece of apparatus. Its range certainly was exceedingly small, not more than the adjustment to an ordinary objective, and suitable only for a cover-glass; but in those days test objects were often mounted between cover-glasses attached to a wooden slip with a hole in it. He had found a description of it in the second edition of 'Quekett on the Microscope,' published in 1852, but it was not mentioned in the first edition of 1848.

Dr. H. C. Sorby's paper, 'On the Preparation of Marine Worms as Microscopical Objects,' was read by the President, who expressed the great regret that was felt on account of the author's inability to be present that evening to read the paper himself. The subject was illustrated by a number of very beautifully mounted slides exhibited under Microscopes in the room.

On the motion of the President, a vote of thanks was passed to Dr. Sorby for his paper.

The attention of the Meeting was then directed to an exhibition of Foraminifera provided for the purpose by Mr. Earland, and shown under a large number of Microscopes upon the table, with written descriptions in which the chief points of interest in each slide were explained.

The thanks of the Society were cordially voted to Mr. Earland for arranging this very excellent exhibition.

The following Instruments, Objects, &c., were exhibited:—

The President:—Set of Three Simple Hand-Microscopes, sent for exhibition by Mr. Edward Swan; a Gillett's Achromatic Condenser.

The Secretary:—A Hand-Microtome, sent for exhibition by Prof. J. W. Groves.

The Society:—Eight Slides of Marine Worms, sent by Dr. Sorby to illustrate his paper.

Mr. J. T. Holder :—Photomicrographs of Larvæ of Gnats, taken from life.

Mr. A. Earland :—Twenty Slides of Foraminifera.

New Fellows :—The following were elected *Ordinary* Fellows :—Dr. Chas. Leo Birmingham, Mr. Edward Clement, Mr. Albert Norman, Mr. Chas. Frank Rowthorn, Mr. Alfred Laudon Whitehouse, and Mr. Wm. Dickerson Wickes.

INDEX OF NEW BIOLOGICAL TERMS, OR OLD TERMS WITH NEW MEANINGS, RECORDED IN THIS VOLUME.

α. ZOOLOGY.

β. BOTANY.

INDEX.

B.

D.

E.

F.

H.

I.

J.

K.

N.

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P.

Q.

R.

S.

U.

V.

W.

X.

Y.

LONDON: PRINTED BY WILLIAM CLOWES AND SONS, LIMITED, STAMFORD STREET AND CHARING CROSS.

CONVERSION OF BRITISH AND METRIC MEASURES.

Computed by Mr. E. M. Nelson from the New Coefficient obtained by Order of the Board of Trade in 1896.

Lineal.

Metric into British.

μ	in.
1	·000039
2	·000079
3	·000118
4	·000157
5	·000197
6	·000236
7	·000276
8	·000315
9	·000354
10	·000394
11	·000433
12	·000472
13	·000512
14	·000551
15	·000591
16	·000630
17	·000669
18	·000709
19	·000748
20	·000787
21	·000827
22	·000866
23	·000906
24	·000945
25	·000984
26	·001024
27	·001063
28	·001102
29	·001142
30	·001181
31	·001220
32	·001260
33	·001299
34	·001339
35	·001378
36	·001417
37	·001457
38	·001496
39	·001535
40	·001575
41	·001614
42	·001654
43	·001693
44	·001732
45	·001772
46	·001811
47	·001850
48	·001890
49	·001929
50	·001969
60	·002362
70	·002756
80	·003150
90	·003543
100	·003937
200	·007874
300	·011811
400	·015748
500	·019685
600	·023622
700	·027559
800	·031496
900	·035433
1000	(=1 mm.)

mm.	in.
1	·039370
2	·078740
3	·118110
4	·157480
5	·196851
6	·236221
7	·275591
8	·314961
9	·354331
10	·393701
11	·433071
12	·472441
13	·511811
14	·551182
15	·590552
16	·629922
17	·669292
18	·708662
19	·748032
20	·787402
21	·826772
22	·866142
23	·905513
24	·944883
25	·984253
26	1·023623
27	1·062993
28	1·102363
29	1·141733
30	1·181103
31	1·220473
32	1·259844
33	1·299214
34	1·338584
35	1·377954
36	1·417324
37	1·456694
38	1·496064
39	1·535434
40	1·574805
41	1·614175
42	1·653545
43	1·692915
44	1·732285
45	1·771655
46	1·811025
47	1·850395
48	1·889765
49	1·929136
50	1·968506
51	2·007876
52	2·047246
53	2·086616
54	2·125986
55	2·165356

mm.	in.
56	2·204726
57	2·244096
58	2·283467
59	2·322837
60	2·362207
61	2·401577
62	2·440947
63	2·480317
64	2·519687
65	2·559057
66	2·598427
67	2·637798
68	2·677168
69	2·716538
70	2·755908
71	2·795278
72	2·834648
73	2·874018
74	2·913388
75	2·952758
76	2·992129
77	3·031499
78	3·070869
79	3·110239
80	3·149609
81	3·188979
82	3·228349
83	3·267719
84	3·307089
85	3·346460
86	3·385830
87	3·425200
88	3·464570
89	3·503940
90	3·543310
91	3·582680
92	3·622050
93	3·661420
94	3·700791
95	3·740161
96	3·779531
97	3·818901
98	3·858271
99	3·897641

dm.	in.
1	3·9370113
2	7·8740226
3	11·8110339
4	15·7480452
5	19·6850565
6	23·6220678
7	27·5590791
8	31·4960904
9	35·4331017

1 metre = 3·2808428 ft.
= 1·09361426 yd.

British into Metric.

in.	mm.
1	25·399978
2	50·799956
3	76·199934
4	101·599912
5	126·999890
6	152·399868
7	177·799846
8	203·199824
9	228·599802
10	253·999780
11	279·399758
1 ft.	304·799736
1 yd.	914·399208

in.	mm.
1/2	12·699989
1/3	8·466659
2/3	16·933319
1/4	6·349994
3/4	19·049983
1/5	5·079996
2/5	10·159991
3/5	15·239987
4/5	20·319982
1/6	4·233330
5/6	21·166648
1/7	3·628568
1/8	3·174997
3/8	9·524992
5/8	15·874986
7/8	22·224980
1/9	2·822220
1/10	2·539998
3/10	7·619993
7/10	17·779985
9/10	22·859980
1/11	2·309089
1/12	2·116665
5/12	10·583324
7/12	14·816654
11/12	23·283313
1/13	1·953844
1/14	1·814284
1/15	1·693332
1/16	1·587499
3/16	4·762496
5/16	7·937493
7/16	11·112490
9/16	14·287487
11/16	17·462485
13/16	20·637482
15/16	23·812479
1/17	1·494116
1/18	1·411110
1/19	1·336841

in.	mm.
1/20	1·269999
1/21	1·209523
1/22	1·154544
1/23	1·104347
1/24	1·058332
1/25	1·015999
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in.	μ
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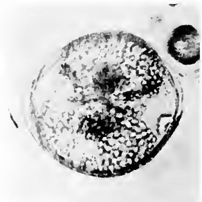

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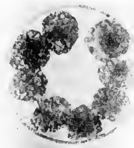

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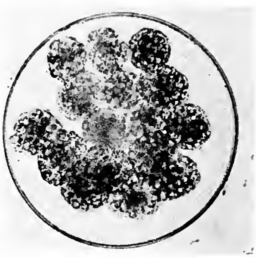

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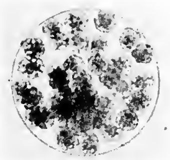

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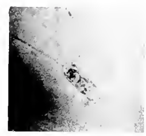

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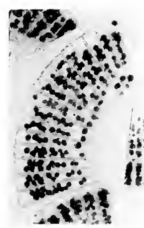

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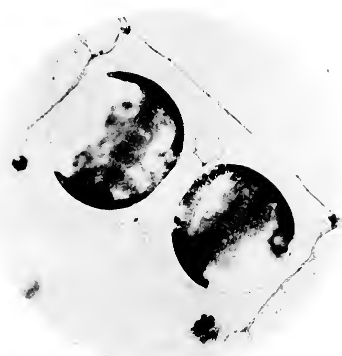

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J. N. Coombe, Photo ad nat.

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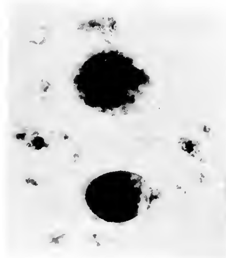

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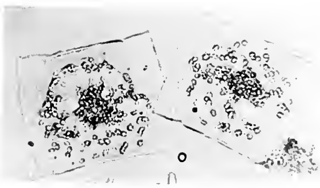

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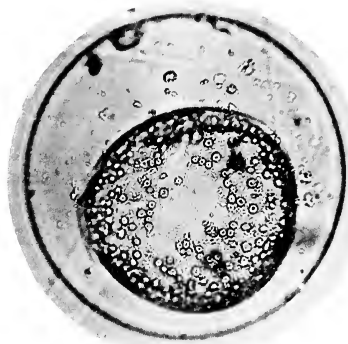

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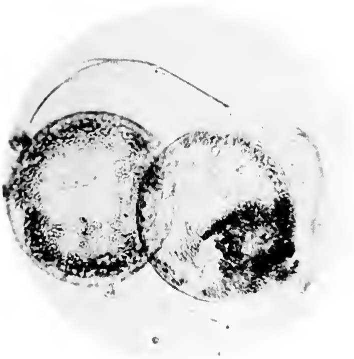

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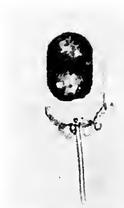

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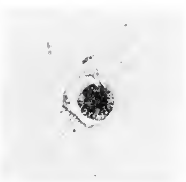

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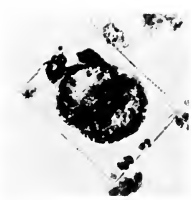

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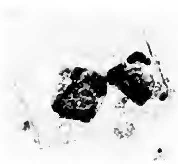

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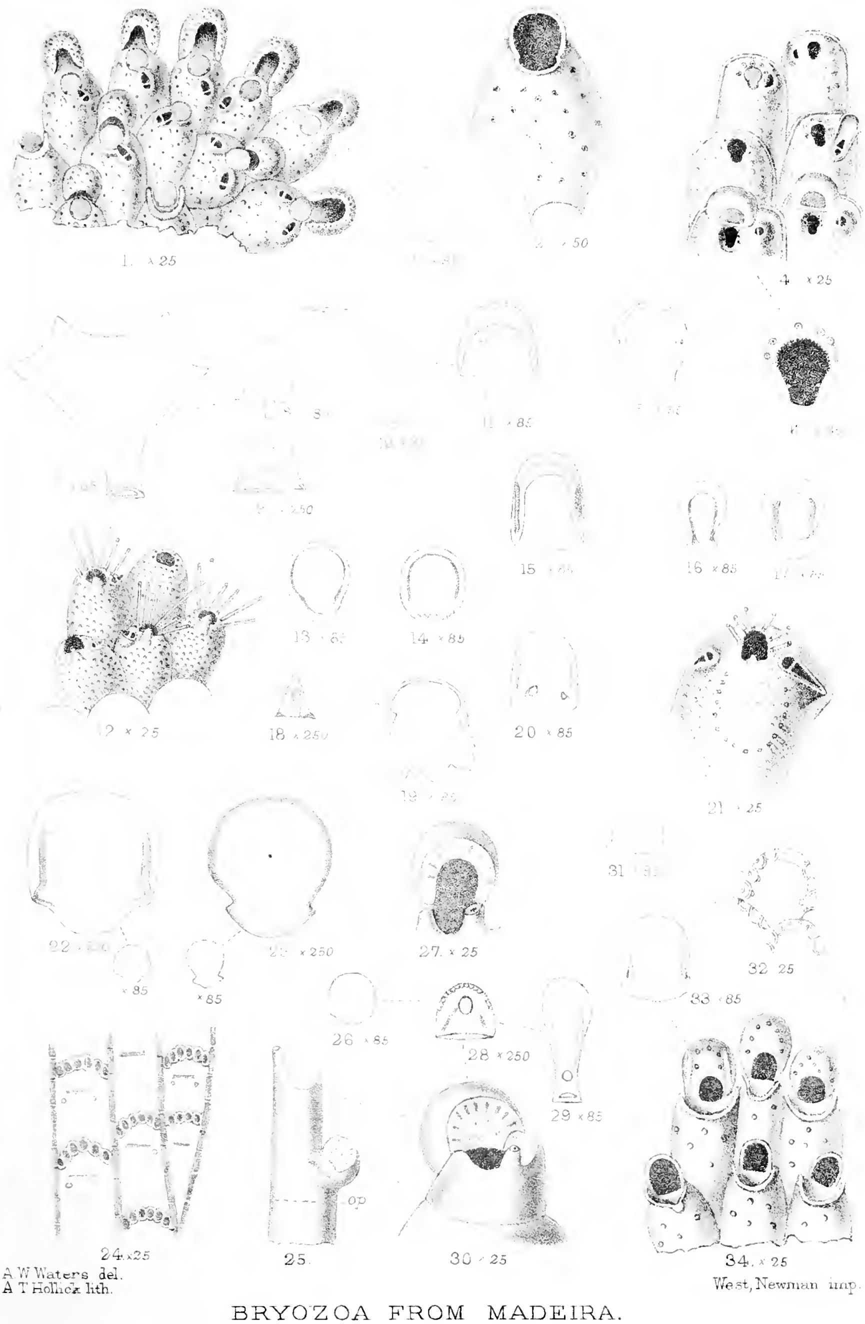

A W Waters del.
A T Hollick lith.

West, Newman imp.

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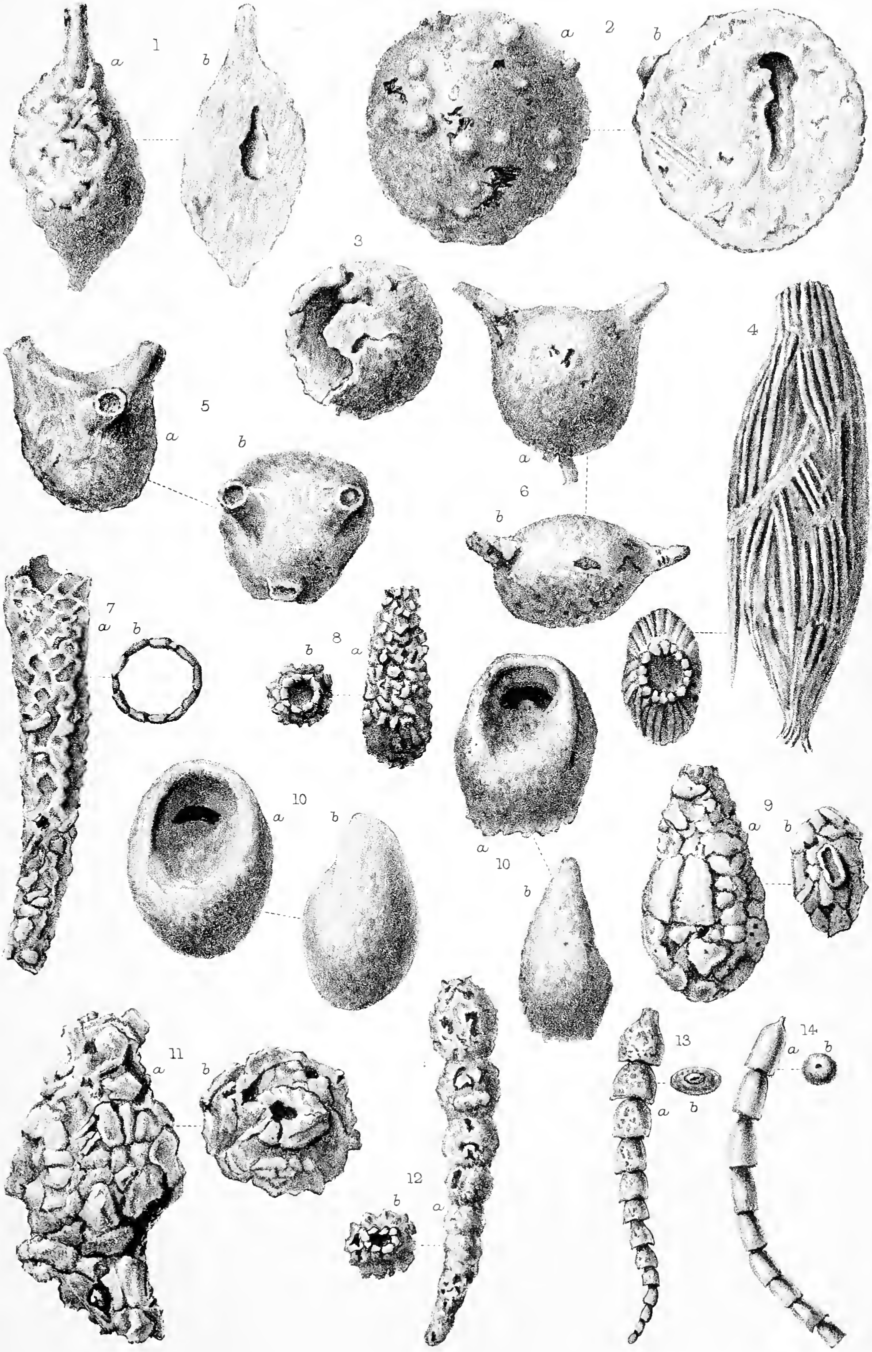


F. W. Millett del. ad. nat.

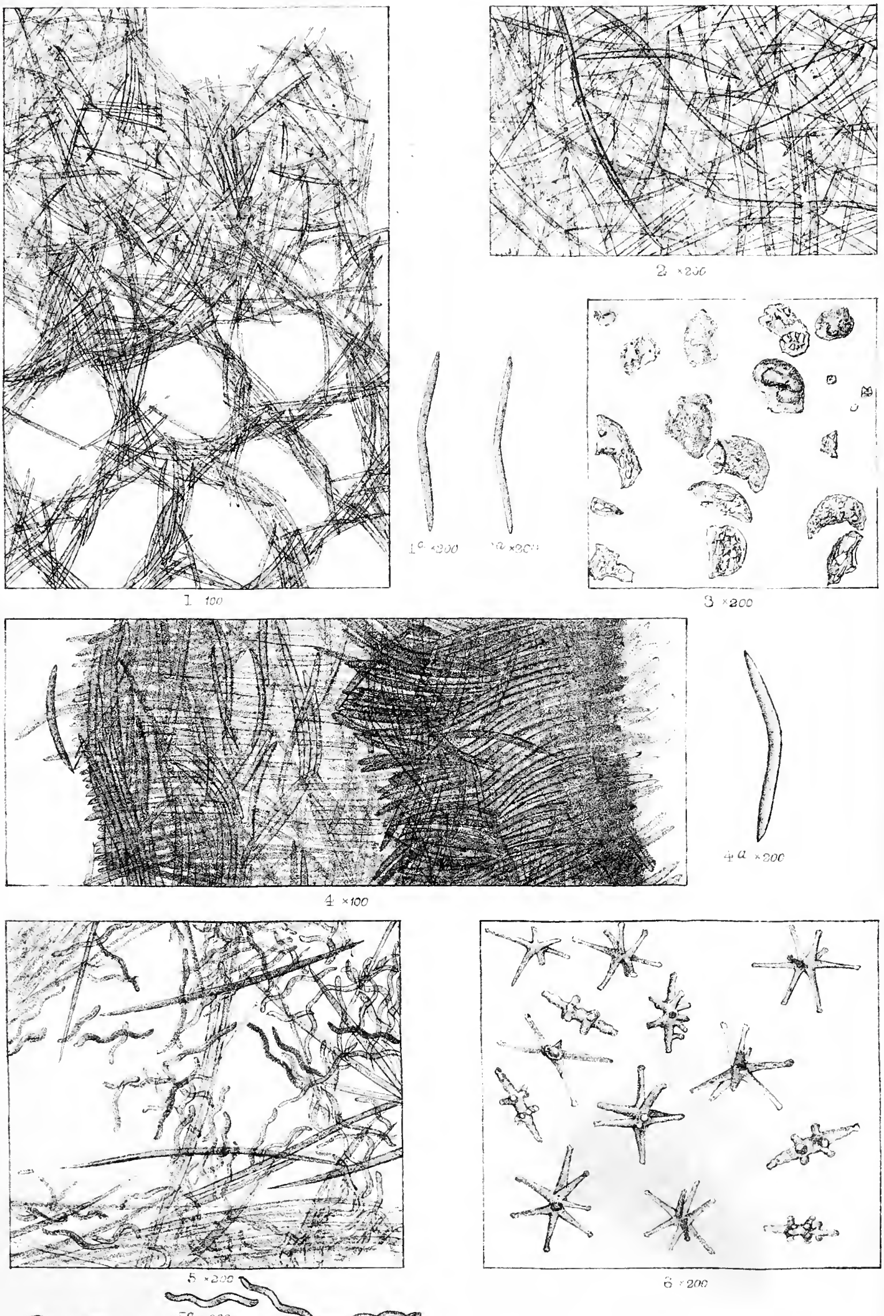
West, Newman lith.

FORAMINIFERA OF MALAY ARCHIPELAGO.

F.W. Millett del ad nat

West, Newman lith.

FORAMINIFERA OF MALAY ARCHIPELAGO.



M. H. Lapidge. del — West, Newman imp.

BORING SPONGES (CLIONIDÆ) FROM MADEIRA.

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ε. Crustacea.

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